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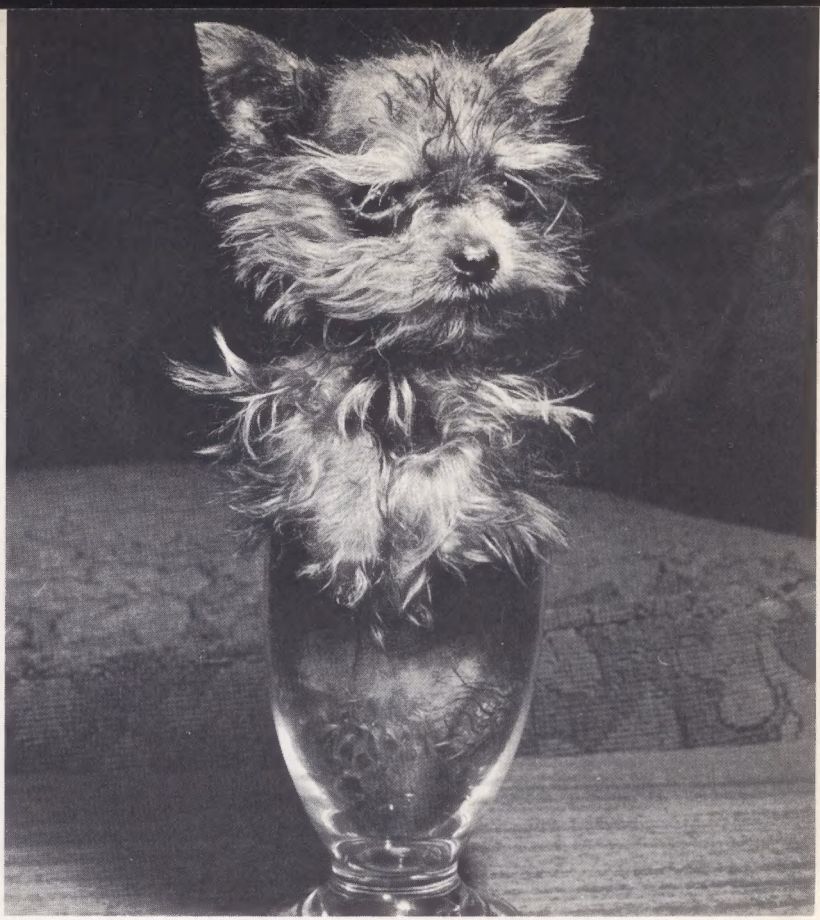

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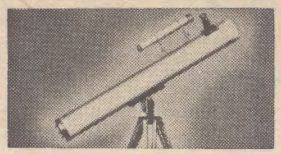

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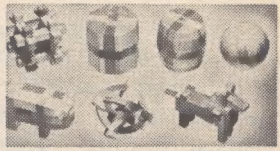

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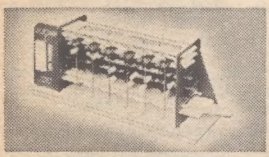

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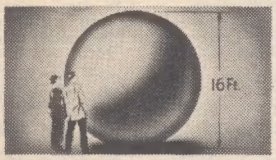

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MEDICAL QUACKS have been with us ever since the first witch brewed bat wings and frog eyes, and chanted a dirge to "cure" some poor unfortunate's scrofulous malady. Recently, the American Medical Association held a two-day National Congress of Quackery in Chicago, to spotlight for people the activities of irresponsible food and diet cultists, self-appointed healers, phony "medical" devices and rem-

THIS MONTH

edies. They rang the bell on chiropractors, whom they referred to as "untrained cultists" with improper credentials to diagnose and treat human disease. "Tax dollars may soon support this," they warned, "by including chiropractors in federal medicare and medicaid programs."

Smelling the makings of a good article, we sent our proficient staff writer, Barbara O'Connell, out to Chicago to learn what she could about frauds, hoaxes and quacks in the medical, drug, food and mental health business. She came back loaded, and you'll find the fascinating result of her interviews next month. You'll read about the "electronic" gadget that flashes diagnostic lights—red and purple for heart; blue and purple for cancer. Screwball fadists are exposed. So are the diet nuts and the snake medicine peddlers. It will be one to read for your own protection.—*RFD*

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DIGEST®

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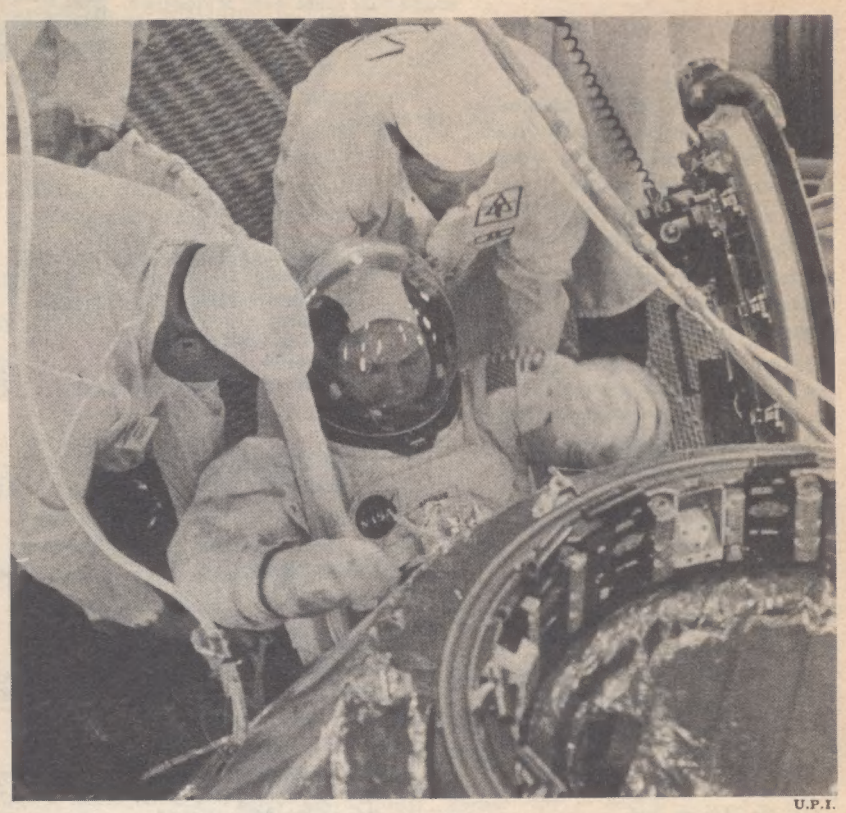
Bulletins at press time



U.P.I.

BRILLIANT COMEBACK FOR APOLLO SPACE PROGRAM. Ever since the tragic deaths of Edward H. White, Gus Grissom and Roger Chaffee in a flash fire during a launch simulation almost two years ago, the Apollo program has been straining to overcome the setback. The resounding success of the October Apollo 7 space flight was the first real indication that the program would indeed catch up. As of press time, it looks as if there will be no "hitch" in the Apollo program's schedule. Navy Capt. Walter M. Schirra Jr., Air Force Maj. Donn F. Eisele and civilian Walter Cunningham scored an almost inestimable success with their 10.8 day space flight. After a 4.5 million mile trip that took them around the earth 163 times in 260 hours, the astronauts returned to earth and millions

of ecstatic Americans. The next step will be Apollo 8 (above), using a 363-foot-tall Apollo-Saturn 5 rocket. This phase will likely be accomplished this month. Air Force Col. Frank Borman, Navy Capt. James A. Lovell Jr. and Air Force Maj. William A. Anders will fly the space craft in one of three possible orbits: in an orbit of the earth, one swing around the moon or even possibly numerous orbits of the moon for as long as 20 hours at an altitude of 70 miles. The Apollo program has recovered from a depression that at one time seemed almost incurable.

GERMAN MEASLES ON THE WAY OUT? The first test of a vaccine against a natural epidemic of Rubella, or German measles, has proved 93 to 95 percent effective in Taiwan. Scientists hope to have a licensed vaccine ready for the next U.S. epidemic, which is expected in the early 1970s but could come earlier. The 1964 epidemic left an estimated 30,000 stillbirths and birth defects in this country.

SUBWAY PROPOSED TO SAVE VENICE. The wash from the water buses that glide so picturesquely along Venice's canals is eroding the foundations on which the city stands, experts warn. Without the buses, or "vaporetti", Venetians and tourists have no way of getting around. The solution may be a subway system deep enough not to shake the foundations and with branches that will take jobless Venetians to industrial zones.

GNU STEAKS ARE NEW. If you're tired of that same old steak or lamb chop, you may soon be able to savor an impala prime roast, zebra ribs, or a nice giraffe chop. A company called Wildlife Services is shooting and marketing nine species of wild game in the state of Tanzania, Africa. Strict controls are set on how many animals can be killed per year in each of the species. Most of the meal will go to Africans but some is expected to be exported to U.S. markets.

NO PROTECTION FROM ASPIRIN DAMAGE. Heavy doses of aspirin damage the stomach lining even when the aspirin bypasses the stomach because the drug acts as it circulates in the blood, says the University of Chicago. The result for arthritics and others who must take many aspirins over long periods of time is that they can't protect themselves from the drug with buffering compounds or stomach-lining materials.

DARWIN BACK IN COURT. More than 40 years after the Tennessee monkey trial, the U.S. Supreme Court is hearing the case of Mrs. John Epperson of Little Rock, Ark., a high school teacher who challenges the Arkansas statute outlawing the teaching of evolution. Arkansas passed the law in 1928 as a direct result of the conviction of John T. Scopes in Tennessee. Since Tennessee repealed its monkey law in 1967, Arkansas and Mississippi are the only states which still ban the teaching of evolution.

SLEEP YOUR WAY TO A HEART ATTACK. People who sleep ten or more hours a night are more likely to have heart attacks or strokes than those who sleep seven hours a night, according to a six-year study of 800,000 men and women conducted by the American Cancer Society. It's not yet clear if the excessive sleep is a symptom or a cause, but Dr. E. Cuyler Hammond of ACS says, "Women ought to get their husbands out of bed on Saturday morning and onto the golf course."

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Saint Peter's bones—are they or aren't they?

The Bettmann Archive

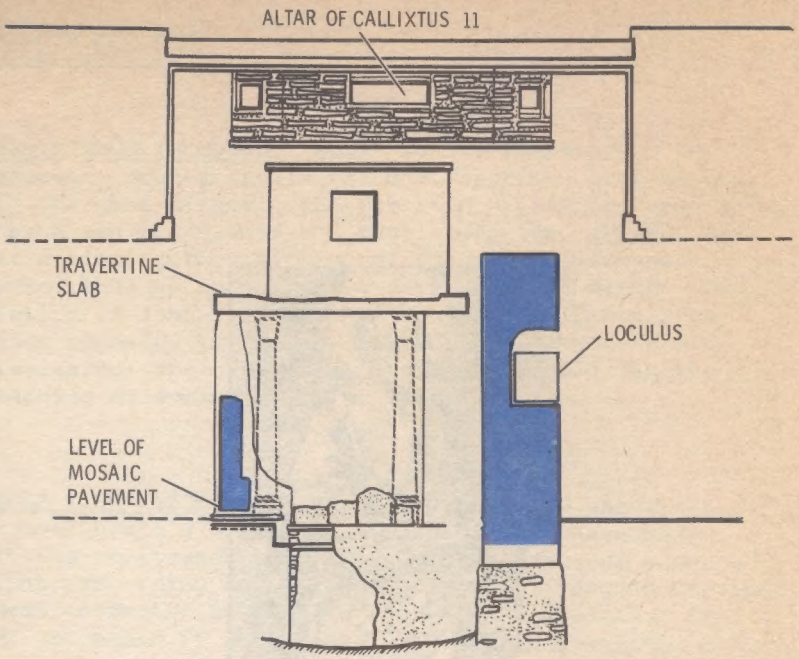
Pope Paul accepts Vatican archaeologists' theories that St. Peter's remains have been found. Other experts aren't so sure.

by Barbara O'Connell

ARE A BOX OF BONES without a skull, a jumble of faint inscriptions and a buried shrine important clues in the solution of an ancient archaeological mystery? Or are they unrelated facts juxtaposed to prove a theory?

Early last summer, Pope Paul XXIII declared that bones unearthed in an area below St. Peter's Basilica in the Vatican had been identified to his satisfaction as the bones of St. Peter, first Pope of the Roman Catholic Church, who died in either 64 or 67 A.D. The evidence was provided by a team of archaeological experts who had analyzed the grave site and the artifacts it contained.

The most important evidence was



Drawing by George Blow

Second-century shrine within fourth-century shrine built by Constantine contained three niches from top to bottom. First cache of bones was found below bottom niche. Bones which have been identified as St. Peter's came from loculus, the opening in wall at right.

provided by Dr. Venerando Correnti, a University of Rome anthropologist, who identified a box of bones found below the basilica as those of a robust man about 5 feet, 4 inches tall, and from 60 to 70 years of age. Only about 60 percent of the skeleton was found and the skull was missing. But the description of the remaining bones tallies with what little is known about Peter.

The bones came from a site near a small monument uncovered earlier in the excavations and identified as St. Peter's tomb in 1950. On a wall near the shrine are a number of faintly scratched inscriptions—"graffiti"—that overlap each other and are written, for the most part, in a kind of code. The name "Peter" would appear to be conspicuously missing from the wall in fully spelled out clarity.

However, Professor Margherita Guarducci of Rome University, who is an expert at reading ancient Roman and Greek inscriptions, believes that the graffiti scratched on the wall near the bones *does* include the name of Peter "dozens of times," either abbreviated or symbolized. She translates one inscription as "Peter is buried within."

Although this evidence has apparently convinced Pope Paul, ex-

perts not involved in the excavation work are still not sure. Their doubts revolve around certain points:

Why was a medieval coin found in the niche with the bones? (It's suggested that the bones were placed in the niche later or, at least, that the niche was opened long after Constantine's time.) Why was only half of a skeleton found of the presumably highly-valued remains of the first Pope? Why were the bones found to one side of the monument and not within it?

The strongest objection to the Peter's bones theory is that so little is known of St. Peter. Without some clues to his physique, such as a bone deformity, say many scientists, it's impossible to identify his bones. "The bones could be anybody's," says Dr. Judice Cordiglia, professor of forensic medicine at Turin, pointing out that the area below the Vatican was a cemetery in Roman times.

"You couldn't identify Peter absolutely on the basis of the bones themselves," maintains Dr. William A. MacDonald, a professor of classical archaeology at George Washington University in Washington, D.C. "The *context* is the important thing. If you could definitely establish that the graffiti was connected with the shrine, I might say, 'Yes, the bones are Peter's.' But you'd have to have some evidence from Peter's time."

For that matter, some experts doubt that Peter was even in Rome. According to ancient tradition, Peter lived his last years in Rome and was martyred there. The tradition is widely accepted, and not only by Catholics. "I don't see why Peter couldn't have been in Rome—the city was full of people from the East at that time," points out Professor Alfred Frazer, who teaches classical art and archaeology at Columbia University. But conclusive proof is lacking.

Dr. Guarducci, the spokesman for the Vatican archaeological group, vehemently rebuts objections to the identification of the bones. "These are tortured explanations unsupported by evidence. They imply a series of coincidences—for example, that this other person buried there was of the same stature and age as St. Peter."

A coin, a mouse skeleton

She notes that the medieval coin found with the bones could have dropped to the sealed niche by the same cracks that let in a mouse whose skeleton was found in the box. Pilgrims to St. Peter's Basilica often dropped coins in the vicinity which has long been associated with the first Pope. The missing bones, Miss Guarducci continues, could have been lost when a wall was constructed near the original grave. As for the location of the bones, she and her colleagues say simply that the niche is the only possible container anywhere on the monument other than the dirt-filled opening underneath it, so it *must* contain the bones.

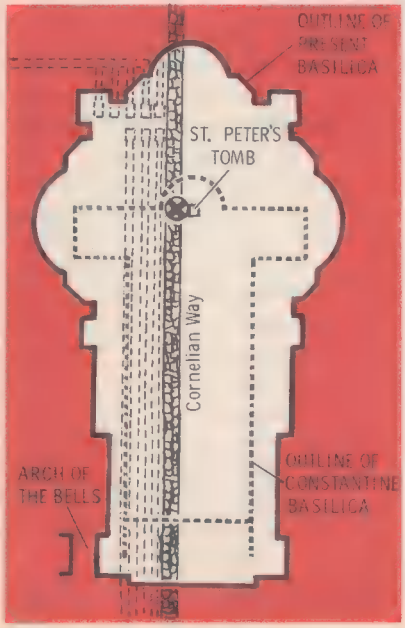
To put both sides of the argument

in perspective, let's go back to the first period of Vatican excavations, which began in 1939. Directly under the altar of the confession in St. Peter's Basilica, archaeologists encountered, first, an altar erected by Pope Callistus (1119-1124), then one put up by Pope Gregory (590-604). Still lower, they found the monument built by Constantine in the fourth century. Within this fourth-century shrine are the remains of a still earlier shrine dating from the second century.

The second-century shrine, from what can be learned of it in its present state, is a small structure with three niches set one above the other. Underneath the bottom niche was a cache of bones which turned out not to be the right age, size or, in one case, sex for St. Peter. In the wall at the side of the shrine, however, is a small, box-like opening that was apparently added to the wall before Constantine's basilica was built. When it was opened, the marble-lined interior held bones, a medieval coin and scraps of cloth. It is these bones that have been identified as Peter's.

Cross marks niche where St. Peter's bones are said to have been found. Parallel dotted lines show earlier site of Nero's Circus.

Drawing by Geroge Blow



The bones in the wall were held in so little regard when they were first discovered that a Vatican workman was told to put them in a box and store them out of the way. They lay in the storeroom for 13 years until Miss Guarducci became interested in the wall niche. The workman led her to the storeroom and the bones. "As soon as I saw the cloth remnants, I knew that these bones must have been important," she says. "The cloth was of rich purple material and was worked with pure gold."

She thinks that Constantine removed the Apostle's remains from the earth grave where they were found—possibly directly under the shrine—wrapped them in the cloth and stored them in the marble-lined compartment in the wall "to insure their permanence."

It could have happened that way. The area below the basilica was used as a graveyard by the Romans, very possibly as early as the first century, when Peter died. A number of anonymous early graves have

been discovered in and around the shrine identified as Peter's tomb. All of these burials were "inhumations" or burial of the whole body instead of cremation, the normal Roman rite at that time. Since Christians all practiced inhumation, the graves may well be those of Christians, and one of them could have been Peter's.

Adding support to this theory is the tradition that Peter met his martyr's death in Nero's Circus, or arena. Recent evidence, including an inscription on the tomb of a wealthy Roman unearthed in the Vatican excavations, indicates that part of the arena was actually on the site of St. Peter's Basilica.

But if Constantine did find Peter's grave and place the remains in the shrine, they may not have stayed there. One archaeologist, who prefers to be anonymous, says he has no doubts that the site is the tomb and that Peter's remains were buried there. But he thinks the body was put in the logical place, under the floor of the shrine, and that the shrine was then opened by barbarian invaders and the casket with the bones stolen. The Saracens occupied and looted St. Peter's in 846, and one source says the invaders "bore off all ornaments and treasures, together with the very altar which had been placed over the tomb of the said Prince of the Apostles."

Whether or not the bones are St. Peter's, the Vatican excavators have undoubtedly uncovered some of the most fascinating archaeological material found in this century. Constantine built his fourth-century church over a Roman graveyard of the second and third century and the present church occupies the same site, so the excavations revealed monuments that had been hidden for some 1,600 years. Some, like the ones in the immediate vicinity of Peter's shrine, probably consisted only of a stone slab laid on top of the body, but others were ornate structures, resembling modern mausoleums, attesting to their owners' wealth and culture.

The most important mausoleum uncovered in the long-hidden cemetery is probably the tomb of the Valerii family, which boasts an assortment of white stucco carvings. Every niche and recess in the upper part of the large structure is occu-

U.P.I.

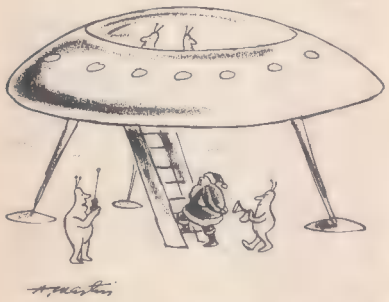
Pope Paul kneels at tomb of St. Peter. Convinced that the discovered bones are St. Peter's, he had bones placed in tomb.

pied by a full-size stucco carving representing either a god or goddess or a human. Stucco portrait busts commemorate members of the family, while low relief figures of satyrs, maenads and pans fill the back walls, and sculptured heads support the cornice. When the tomb was intact these sculptures were probably enlivened with splashes of polychrome and gilt.

The Valerii tomb is important for another reason besides its fine stucco carving. Professor Guarducci found two primitive portraits scratched into a wall of the mausoleum; one of Christ and the other, she says, of Peter. Peter is shown as an old, bald man with a long beard. One tradition *does* indicate that he was bald. To the left of the head are the letters "PETRV" and to the right, an inscription that is translated by Miss Guarducci as "Peter, pray for the pious Christian men buried near your body." When she first saw the inscriptions in 1952, she says, they were quite visible, but now, unfortunately for her case, they have almost vanished.

Why would Constantine build a basilica right over a graveyard, undoubtedly angering the wealthy owners of the tombs? The evidence shows that the mausoleums were in use up until the time they were covered by the foundations of the church. The considerable slope of the ground here, too, is unsuitable for a large building, making it necessary for the architects to dump tons of earth on the site to level it out. Nearby on Vatican hill at that time were any number of open, flat spaces on which the emperor could have erected a church. The reason for the choice of the site seems inescapable: Constantine had to build his basilica there because the site held something he wished to incorporate within the building.

Was that something the tomb of St. Peter? Accepting the graffiti as translated by Miss Guarducci, a good circumstantial case can be made for the second-century shrine being dedicated to Peter and, perhaps, for its being his tomb. But the presence of the bones within the shrine is another matter. The identification of the remains will have to remain uncertain, at least until the complete scientific evidence compiled by the Vatican archaeologists is made public.



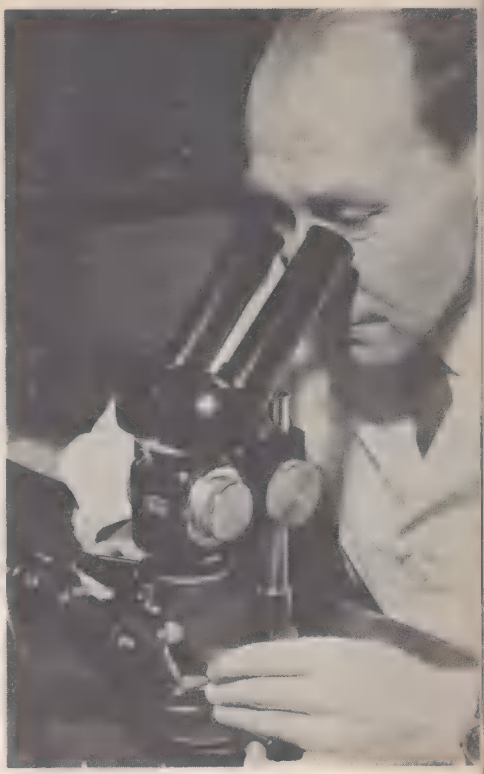
"Earthman captured. Stand by for blast off."

Operation on an insect's brain

BRAIN SURGERY is delicate enough business under ordinary circumstances, but the operations Prof. Arne Semb Johansson of Norway performs have complexities that are greatly magnified—literally. He operates on insects' brains under a stereo microscope that enlarges 25 times.

Working in the zoological department of the Blindern University in Oslo, Prof. Johansson studies hormones produced in insect brains.

The "patient" is anesthetized with ether and placed on a plastelene pillow beneath the microscope. Instruments with points so fine that they can't be seen with the naked eye are used to remove the exoskeleton and tissue surrounding the brain. A group of about ten cells is extracted from the brain, after which the exoskeleton is replaced where it will rapidly grow back to its original state. No sutures are necessary. The insects usually recover.



PIP

Prof. Johansson prepares to operate on a fly's brain while viewing his "patient" through a stereo microscope which magnifies 25 times. He makes incision (below left) with very fine instrument, then removes tissue surrounding brain (right).

American Museum of Natural History

Rats are considered the most dangerous carriers of diseases that infect humans. Plague, typhus, jaundice, tularemia, typhoid, trichinosis and rabies are the most common diseases they transmit. Plague alone is said to have killed more people than all wars in history.

ZOONOSES— animal diseases you can catch

Zoonoses are not, as you might suspect, monkey or anteater schnozzles. They are communicable diseases animals carry and pass to humans.

by Barbara O'Connell

In late July, 1967, a laboratory in West Germany received several shipments of African green monkeys, a small primate with a long tail, from Uganda. Following the usual procedure, workers removed the monkeys' kidneys preparatory to making virus cultures for polio vaccines. By September, 24 of the personnel who had handled the monkeys fell ill with the same symptoms: prostration, nausea,

vomiting, diarrhea, aching muscles. Doctors who examined the stricken workers were unable to diagnose the symptoms, but they found evidence of liver, brain and heart involvement. Within 12 days, seven of the lab workers were dead.

A similar illness was reported from Yugoslavia. Like the German outbreak, the Yugoslav illness involved workers in a laboratory who had handled the tissues of African green monkeys. In all, some 30 persons in both countries were afflicted, including medical personnel who attended the patients.

Scientists began a search for the cause of the mysterious disease. In the meantime, an embargo was placed on shipments of green monkeys by the Uganda government, and the U.S. barred the release of any polio vaccine produced after July, 1967. By late winter, the probable agent of the disease had been identified: a virus, previously unknown, which is highly infectious and resistant to known treatments. Apparently the virus is carried by green monkeys, which can transfer it to man. Although the animals had been shipped to a number of countries, including the United States, before the embargo was put into effect, no further outbreaks of the "green monkey disease" were reported. Bans on monkeys and vaccine were lifted.

Green monkey disease is the newest name to be added to the long list of maladies known as "zoonoses" (zo-on′-o-sees). Zoonoses are diseases which can be transmitted from animals to man or, in a few cases, from man to animals. There are over 100 of them, a number that is expected to increase with the exploding animal population and man's increasing contact with exotic species. In most zoonoses, an insect vector—mosquitoes, ticks, flies, fleas and lice are the most common—carries the disease from animal host to man; but some are transmitted directly. The animal host is often unaffected by the zoonosis it carries even though it may mean grave illness or death to man.

Which animal is the most dangerous to man from the point of view of zoonoses? Most authorities would probably choose the rat, which carries the disease of plague, typhus, jaundice, tularemia, typhoid, trichinosis and rabies, among others. Plague alone is said to have killed more people than all the wars in history. The insect vector of the

Green monkey disease killed several lab workers who were making virus cultures for polio vaccine from monkeys' kidneys.

Yerkes Primate Research Center

disease is the rat flea, which migrates to humans when its normal host dies of plague. The plague bacillus, *Pasteurella pestis,* was discovered in 1894, and it took until the turn of the century to work out the sinister relationship between rats, fleas and the human disease.

The rat's rodent relatives, the lemming, the squirrel, the guinea pig and the gerbil, are also capable of infecting man. A gerbil-carried disease broke out recently in Russia when a construction party was sent into the desert region of Turkmenia to set up a project along the Murgab River. Almost as soon as the workers arrived at the isolated site, they began visiting the dispensary to be treated for skin ulcers resulting from sandfly bites. About 50 workers a day were stricken. Investigation showed that the sandflies were spreading infection from gerbils carrying the protozoan *Leishmania tropica,* one of the most ancient parasites known to man. When gerbil burrows around the camp were poisoned, the infection vanished.

Another unusual rodent-carried disease outbreak occurred in Israel in 1947. In northern Galilee, the ruins of a castle built by the Crusaders stand over natural caves used as storerooms. Local legend says the castle's builders left in a hurry after they fell ill of a recurrent fever. The site remained uninhabited until a party of young Israelis visited it to establish a settlement. Within a few weeks, most of the party was in the hospital with a recurrent fever. Physicians diagnosed it as endemic relapsing fever, a spirochete infection transmitted by ticks and rodents. Apparently ticks had bitten diseased rodents living in the caves below the castle, then infected the members of the Israeli party—just as they had infected the Crusaders over 1000 years before.

Primates, the animals most like man, can transmit over a dozen diseases to human beings, but only a few have serious implications. The best known monkey-borne disease is jungle yellow fever. The classic form of the disease is carried by the Aedes mosquito and had all but been eradicated in Central and South America in the 1920s when the jungle variety made its appearance. It's carried by tree-dwelling mosquitoes of a different kind than the Aedes. Men occasionally are bitten by the mosquitoes in the jungle and carry the infection back home, where they transmit it to the local Aedes mosquito. In this way, a single case can mushroom into an urban epidemic. An outbreak of jungle yellow fever occurred in Ethiopia in the early 1960s; 200,000 lives were claimed before the epidemic could be stopped.

Most primate zoonoses are transmitted to man only on rare occasions. The Herpes B virus which, like green monkey disease, is acquired by laboratory workers, strikes just a handful of persons but almost always results in a fatal encephalitis. Rabies, monkey pox and hepatitis are all transmitted from primates to man on occasion.

Farm animals are an obvious

American Museum of Natural History

American Museum of Natural History

New York Zoological Society

Parrots sometimes transmit "parrot fever" or psittocasis in nasal secretions or dust from droppings. Armadillos indirectly infect man with sleeping sickness or Chagas' Disease: kissing bug passes disease to man after biting armadillo. Man sometimes infects owl monkeys with Herpes Simplex infection. Sickness is not serious in man but is almost always fatal to owl monkey.

source of infection for man. Cows transfer undulant fever to man through their milk or reproductive organs, most of their victims being farm families or meat processing workers. The malady, which can become chronic, is marked by fever, chills, sweats and aching muscles. Swine are also hosts to the trichina worm that causes trichinosis, acquired by eating undercooked pork. Both cattle and swine are carriers of the *Leptospirosis* bacteria, which invade man's body through a cut or through his eyes, nose or mouth and produce a flu-like illness. The bacteria *Salmonella* that sometimes infests milk, meat and eggs causes the symptoms of food poisoning or a typhoid-like malady.

Horses sometimes harbor the virus of encephalitis and the bacteria of tetanus. Health officials in New Jersey recently became concerned about an outbreak of encephalitis, or sleeping sickness, among men and horses. Three persons and at least 90 horses had died of the disease by the end of the summer of 1968. In 1959, 22 persons succumbed to sleeping sickness in New Jersey. The Eastern variety of sleeping sickness is apparently spread to birds by a fresh-water mosquito

that rarely bites man. A salt-marsh mosquito, common along the New Jersey coast, picks up the virus when it bites an infected bird and then passes it along to men and horses.

Hunters are the most likely persons to be exposed to tularemia, usually transmitted directly by rabbits. Sometimes quail and grouse catch tularemia, transferring it to persons who clean the birds. The disease produces high, irregular fever and coma and blindness in severe cases. In Africa, game animals are known to carry sleeping sickness, transmitted to man by the tsetse fly.

What about pets? One expert claims that "pets probably play only a minor role as a cause of human disease." But the dog can be host to an alarming list of zoonoses, including Chagas' Disease, an often fatal South American fever allied to African sleeping sickness; an unpleasant quartet of infections called leishmaniasis, one form of which attacks the body's cellular defense system and another of which causes ulcerous sores of the mouth and nose; Rocky Mountain Spotted Fever, a tickborne illness with symptoms of fever, hemorrhages, rash, nausea and convulsions and death; and leptospirosis, the same bacterial disease that is carried by farm animals. The Agricultural Information Department at North Dakota State University recently issued a warning that dogs can transmit leptospirosis to humans in swimming pools or beaches.

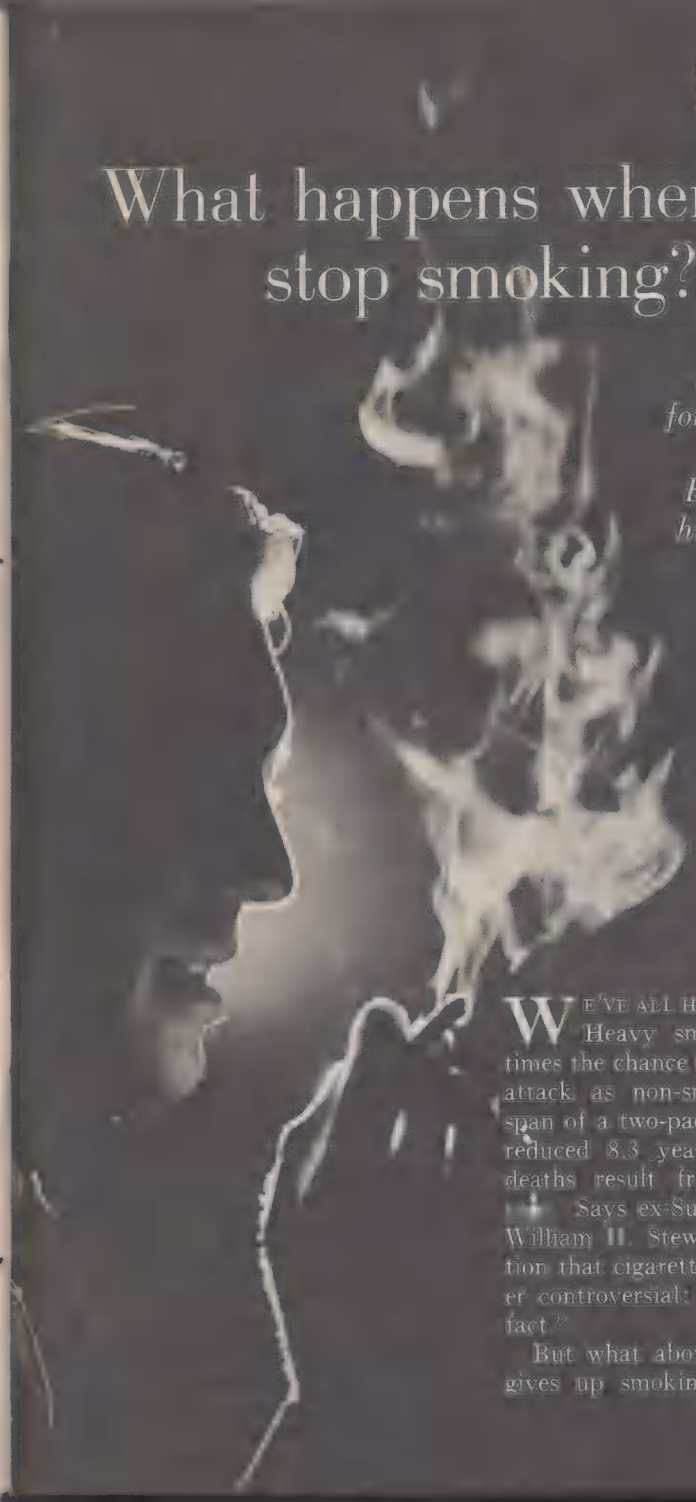
Cats, while less liable to transmit disease than dogs, help spread Chagas' Disease and may be a factor in toxoplasmosis, a malady marked by such symptoms as fluid on the brain, eye inflammation and convulsions.

A malady like Chagas' Disease is a serious threat in some areas but most zoonoses are rather rare, affecting only limited groups. The chances that the average persons will contact, say, the organs of an infected green monkey are almost nil. Vigilant public health measures, too, have undoubtedly decreased the incidence of animal-transmitted disease. In 1967, not a single death from rabies occurred in the United States. Plague no longer causes the fearful death tolls it did from the 14th to the 17th centuries.

But epidemics of zoonoses still occur in parts of the world every year. The reasons are various. In some cases, vaccines exist, but information is lacking on how to apply them on a large-scale basis in primitive areas. Even though a yellow fever vaccine is available, it still hasn't prevented hundreds of thousands of deaths in some parts of the world. Only recently, monkeys, dogs and cats were found to be reservoirs of the well-known agent that can cause elephantiasis and blindness. Migratory animals can introduce disease into areas where they had not existed before or where they had been eradicated.

And in not a few cases, no effective treatment exists for zoonoses, old or new. A zoonosis, even a rare one, is a disease to respect.

What happens when you stop smoking?



After smoking for 15 years, this writer quit. Experts showed him what is now happening to his body.

by Robert Gannon

WE'VE ALL HEARD the statistics: Heavy smokers have three times the chance of suffering a heart attack as non-smokers. The life-span of a two-pack-a-day smoker is reduced 8.3 years. Some 300,000 deaths result from smoking each year. Says ex-Surgeon General Dr. William H. Steward: The proposition that cigarettes kill "is no longer controversial; it is flat scientific fact."

But what about the person who gives up smoking after devouring

cigarettes half his life? What happens to his body when he stops?

Recently I gave up smoking. As part of my "therapy" in getting through the withdrawal period I read scientific papers, poured over medical slides, talked for hours with physiologists. I have a good idea of the changes my body is undergoing —changes that happen to everyone who quits for good. For 15 years I had been a two-pack-a-day filter-brand man who inhaled deeply, coughed gustily and lit another while the first still burned in the ashtray. I had begun to brood about lung cancer and heart disease. After many tries, I quit.

For awhile it was rough. I chewed gum until my jaws ached, drank coffee until it colored me umber, ate everything in sight and gained five pounds (which I later lost).

When I found myself searching gutters for butts, I borrowed a cabin five miles from the nearest store and vented my frustration by clearing a woodlot. I wielded that ax like a wildman, dropping from exhaustion every so often to cram another wad of gum into my maw.

Slowly, withdrawal troubles eased. Since then, a number of biological changes have taken place. My teeth became noticeably whiter. My mouth no longer tastes like the inside of a stevedore's gloves. And I don't cough. When supper is cooking, I can smell it.

But aside from obvious changes, I've learned that more important ones are happening, physiologically —things medical science only recently has begun to comprehend.

The chemistry of cigarette smoke is a nightmare of complex compounds—at least 270, perhaps as many as 800 of them—including such dandies as ammonia, formaldehyde, hydrogen cyanide and arsenic. At least one radioactive element—polonium 210—has been identified. And pathologists at the Southwest Research Institute in San Antonio, Texas, have detected tiny amounts of poisonous methyl cyanide in the body fluids of smokers.

The most famous ingredient of cigarette smoke is nicotine. A stimudepressant (it first stimulates, then depresses), it affects the central nervous system, boosting the heartbeat 15 to 25 beats a minute, while it shrinks blood vessels—particularly in the extremities. The temperature of smokers' fingers and toes declines considerably after a cigarette. This can be dramatically shown in pictures taken by thermography. (See the *Science Digest* Special, page 35, this issue.)

Nicotine, for some reason, stimulates the flow of certain hormones —for example, adrenaline, the substance that prepares the body for a fight; or serotonin, a chemical active in the brain; or hypothalamus-produced pitressin, a diuretic-antidiuretic chemical. What effect these have in long-term absorption, however, is still unknown.

When you take a deep puff, the smoky air travels down your trachea, then branches into the bronchial tubes to countless tiny elastic lung chambers called alveoli.

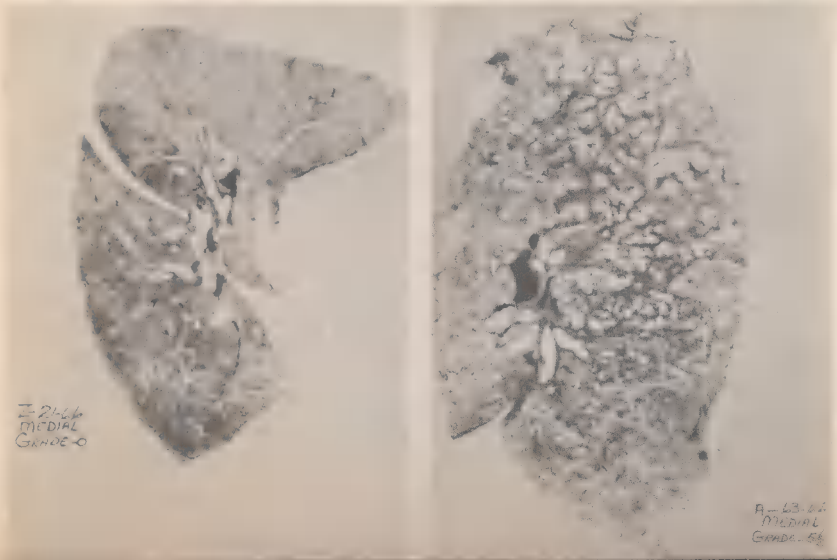
Between the chambers are minute vessels through which blood flows as it dumps accumulated carbon dioxide and takes on fresh oxygen. How much smoke actually reaches your alveoli depends on how deeply you inhale. Normally, about half the matter that makes up smoke is deposited somewhere along the way.

What happens to all this material —collectively called "tar"? Most of it is carried back up the throat on the surface of a built-in conveyor belt that lines the bronchial tubes and windpipe. The belt is made up of millions of *cilia*, tiny hair-like cells that whip back and forth in rhythm—about 17 beats per second—pushing along a film of mucus. Dirt from the air which is deposited on this conveyor belt is carried up to the throat where it is swallowed. Eventually smoke fouls up this tidy system. It paralyzes the cilia. And if they remain paralyzed too long, they disappear.

This has two immediate effects: (1) Smoke particles and other debris in the air settle on the walls of the windpipe and stay there. (2) The glands producing moisture for the conveyor belt secrete at a higher rate, but the mucus isn't carried off. *That* is the main cause of smoker's hack. What chronic coughing does to alveoli is horrendous.

Look through a microscope at the alveoli of a smoker and you'll see that the walls between them are oddly thickened. They have lost their elasticity. Smokers are able to exhale less air than non-smokers (the reason for that typical shortness of breath). Blood vessels be-

Normal lung tissue (left) has air sacs or alveoli that are too fine to be visible, but lung tissue of heavy smoker (right) shows greatly enlarged air sacs—probably caused when mucus-blocked air sacs burst under the tremendous pressure of chronic coughing.



tween alveoli also have become thick-walled, fibrous and narrowed. Sometimes they're completely blocked. Thus the system has lost capacity for trading carbon dioxide for oxygen. Moreover, mucus from those over-stimulated glands finds its way to the alveoli and plugs their inlets, often trapping air inside.

How the coughing hurts

Now the smoker coughs. Air pressure builds up so high in some alveoli that walls between burst through, ripping apart the tiny blood vessels and eliminating the two adjacent alveoli from full usefulness. The Cancer Society's Dr. Hammond believes that the prime cause of alveoli rupture is "abrasion" from smoke. Nevertheless, he says, "Coughing produces a tremendous momentary increase in pressure. If you take a garden hose with a weak place in it and increase the water pressure by a factor of ten, chances are it will burst . . . There is no direct evidence, but . . . well, I prefer not to cough."

As alveoli decrease in number and the efficiency of those left is impaired, the heart must pump harder to send more blood through the sacs still working—a job already made difficult by the blood-vessel-constricting nicotine. That's one reason people with heart trouble are advised to stop smoking.

In a pathology lab in the Veterans' Hospital in East Orange, N.J., I examined a file of preserved lung slices from people who died and underwent autopsy.

Dr. Oscar Auerbach is the hospital's senior medical investigator and a leading pathologist. He offered me suggestions as though they were orders.

"Here are two piles of typical lung sections," he said. "These are from smokers; these are from non-smokers."

The difference was astonishing. The lungs of the non-smokers were pinkish gray, and with the exception of an occasional yellow or blue spot—a lymph or blood vessel cross-section—the color was fairly uniform and clean looking. The cross-sections of smokers' lungs were blotched with ugly black, where smoke and other debris had been deposited. To me, they looked impressively disgusting.

Even more impressive, however, was the structure of the two samples. The non-smokers' lungs appeared even-textured and smooth, like thin sections of raw steak. But lungs of heavy smokers were often riddled with large jagged holes, like Swiss cheese, or perforations from a shotgun pattern—places where alveoli had broken through by the hundreds. "This is what I think is dramatic," said Auerbach. "These smokers were walking around with holes in their lungs."

Such smokers are well on their way to cancer. Here is the most probable sequence, as reconstructed by Dr. Auerbach, Dr. Hammond and others:

First, smoke paralyzes cilia in the bronchial tubes, eventually destroy-

"What chronic coughing does to those little lung sacs called alveoli is truly horrendous."

ing them and settling on the bare spots. Cancer-causing substances begin to irritate the surface, or *columnar* cells (they look like columns from the side)—along with underlying *basal* cells, so called because they make up the "base" of the tissue lining.

Some basal cells begin to divide and build layers, like calluses, to ward off irritation. The columnar cells flatten, to *squamous* (scalelike) cells. "This is the first true change toward a cancerous condition," says Dr. Ronald Vincent, thoracic surgeon of Buffalo's Roswell Park Memorial Institute.

Then the cells start to go through a more basic change, probably a transformation to the DNA chromosomes, until they no longer resemble the parent cell. Under a microscope the nuclei of these new cells look misshapen. Pathologists call these "cells with atypical nuclei." An *occasional* cell of this type can be found in lungs of non-smokers, "presumably the result of somatic mutation . . ." conjectures Dr. Hammond, "maybe coming from cosmic radiation or goodness knows what." But in the young, light smoker, he says, "you might find two percent, and in the old, heavy smoker, you may find anywhere from 60 to 80 percent of cells with atypical nuclei. And there will be areas in which *all* the cells are atypical." Though concentrations of such cells are found in the lungs of virtually all smokers, no such concentrations have ever been found in non-smokers.

Eventually these cells begin to multiply furiously, breaking through into underlying tissue. Now the condition is called bronchial carcinoma. If the cancer is surgically removed, or if all the cells are killed, the patient usually survives.

But finally some of the cancer cells break loose from the parent mass and migrate to other parts of the body to build additional tumors. (When a man dies of lung cancer, he ordinarily has half a dozen other undetected cancers thriving.) Then there is almost no hope.

The job of mending

I, however, am now an *ex*-smoker. To what extent can my body mend itself after 1½ decades of smoking? No long-term studies in depth have been attempted, and physicians are hard to pin down. But from what evidence there is, and from opinions of the pathologists, statisticians and physiologists with whom I talked, what probably is happening to me is this:

• *Cilia:* Some of the cilia lining my windpipe and bronchial tubes have disappeared, and cilia rarely, if ever, regenerate. But surrounding cilia do "stretch" to help cover bare spots. The vast majority of them

were made *inoperative* by the smoke, but weren't wiped out. These quickly returned to work.

• *Alveoli:* Damaged lung cells probably never completely return to normal. When walls burst, they don't mend. And fibrous scar tissue will disappear very slowly, if at all. But tubes leading to my alveoli are no longer being plugged, and I've stopped rupturing more with smoke abrasion or coughing. Further, my system no longer is infused with nicotine, so the tiny blood vessels between the alveoli have returned to normal size, and much of the thickening of the walls has reversed. The alveoli are functioning more effectively now—no more shortness of breath, and far less likelihood of the development of emphysema, a disease always aggravated, and possibly caused, by cigarettes.

• *Heart:* I was suffering from no heart trouble, but today no additional strain is being put on my circulatory system. (Dr. Henry I. Russek, a Staten Island, N.Y., heart researcher, in a survey of 25,000 professional men, found that ex-smokers for some reason have even less heart trouble than those who never smoked.)

• *Bronchial-wall cells:* Perhaps the most meaningful discovery of the studies by the Auerbach group was a new kind of cell. "In smokers' lungs we found nuclei of certain cells undergoing contraction, disintegration, disappearence and replacement," says Dr. Auerbach. Such cells have been found *only in the lungs of ex-smokers,* never in the lungs of smokers, never in those who had never smoked.

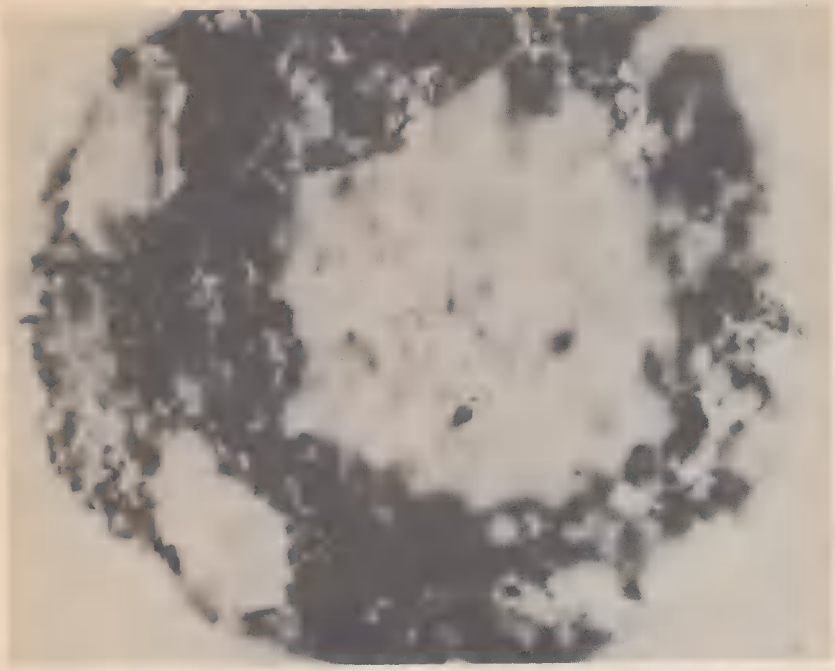
"Apparently these cells are the remains of cells with atypical nuclei," says Dr. Hammond, "probably an intermediate state in the long-term replacement of abnormal (developing cancer) cells." Adds Dr. Auerbach: "These findings show that as a result of *not* applying the carcinogenic agent—the inhaled cigarette smoke—pre-cancerous cells are replaced by the normal cells."

Is recovery ever total?

When can *I* consider myself recovered? In a sense, never completely. Those ruptures won't heal; the scarring doesn't disappear. But the changes in my bronchial lining *are* reversible, and the lining will return to normal. Some authorities believe an ex-smoker's body requires the number of years he smoked to mend itself. Others say it takes 10 years of abstinence to repair the damage.

Most important, however, is something that none of the researchers will say outright, but clearly imply with emphasis. Virtually *every* heavy cigarette smoker who inhales deeply will develop lung cancer, barring other catastrophe. If the ordinary smoker can get through the first year after giving up smoking without physical trouble, however, his chances of developing lung cancer plummet. And in 10 years his chances are the same as though he had never started in the first place.

Science Month



Microscopic algae-like fossil is typical of many forms discovered recently in South Africa. Found in carbon-rich, siliceous sedimentary rock of Onverwacht series.

Oldest fossil on earth?

ARE microscopic algae-like forms unearthed recently in a river valley in South Africa the oldest fossils on earth?

Geologists who have examined the tiny forms think they look like one celled algae. If they're right, the age of life on earth can be thrust back millions of years to as much as 3.5 billion years. The oldest living things known until the new discovery are three billion years old. The earth is over five billion years old.

The South African forms that are causing all the excitement are so small that a million of them could fit in a thimble. Under a microscope, they have the shapes of spheroids, cups and thin filaments. Some are amorphous. Although they're all microscopic, some are 100 times as large as others.

The rocks in which they are em-

bedded are probably the oldest exposed beds of rock on earth. Known as the Onverwacht Series, they make up part of the Swaziland System, a Precambrian formation that is well-exposed in the Barberton-Badplaace region of the eastern Transvaal. The Komati River flows through the area.

To the north is southern Rhodesia, where the oldest fossils known until the present discovery were found.

Dr. Albert E. J. Engel of the University of California, one of the scientists who studied the fossils, thinks they were deposited in an ancient body of water that could have been as small as a puddle or as big as a sea.

He terms the discovery "exciting and disappointing," exciting because it has extended the age of life and disappointing because in all probability no older fossils will ever be found. The origins of unicellular life on earth were buried in older rocks now obliterated, he points out.

"It's beginning to look like the ball game is over in trying to find earlier chemical remains of life," he says. "We may never be able to go beyond this."

Baby mortality high in U.S.

The U.S. spends six percent of its gross national income on health services, but it ranks 13th from the top in infant death rate, according to United Nations figures. Our Negro infant death rate is twice the white. Among nations, Sweden ranks first, followed by Holland, Norway, Finland, Switzerland and Japan. Britain is 10th and France 11th. Below the U.S. are Ireland and Czechoslovakia.

But the U.S. is improving. Baby death rates in this country dropped

BIPS

Pistol thermometer reads temperatures without contact by measuring infrared energy emitted by objects or animals. Measures temperatures from zero to 100 degrees C.; cross-hairs on rifle scope allow exact aiming. Weighing 4½ pounds, unit is powered by batteries. Developed by Levermore Company, Broadway House, Wimbledon, London, England, pistol thermometer is a variation of the thermograph principle discussed in Science Digest Special, page 35, this issue.

more than twice as fast as in the preceding decade, with the Negro rate declining almost twice as fast as the white rate.

Russians wrong on Venus

The surface pressure on Venus is about 75 or 100 times that on earth, or four to five times greater than the pressure reported by Soviet scientists, data from U.S. Mariner V reveals. A pressure 75 times that of the earth's atmosphere is equivalent to that of an ocean depth of 2,550 feet. Researchers at NASA's Jet Propulsion Lab think the Russian spacecraft which reported the lower pressure either landed on a 15-mile-high Venus mountain peak or stopped transmitting before it reached the surface of the planet.

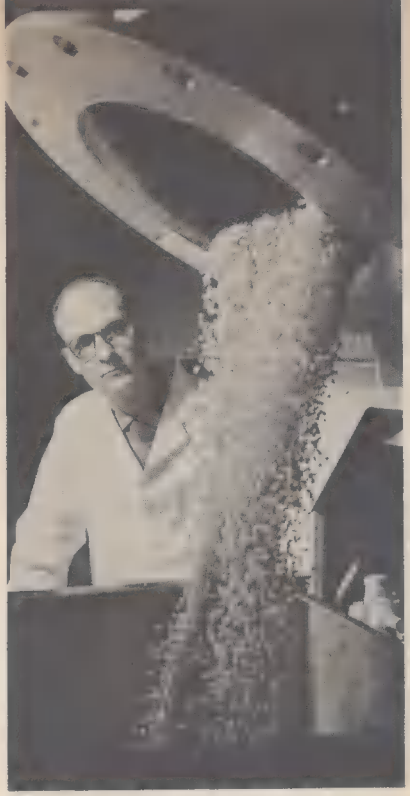
Roman ruins vs schooldays

Two archaeologists digging beneath a peach orchard in Vienne, France, recently came up with what authorities think may be the most important Roman ruins ever discovered in France.

The ruins are a town of the first to third centuries inhabited, apparently, by wealthy Romans. Spacious villas are decorated with colored mosaic tiles, 15 different kinds of marble and elaborate water basins and fishponds.

The well-heeled Romans liked their comfort. Their houses were warmed by stoves beneath the floor and by an arrangement of hollow brick walls that could be heated by fires from below. Lead pipes brought in water and a sewage system carried away waste. Storerooms were kept dry by placing empty olive jars upside down beneath the floors to form a dry-air barrier.

When a Vienne Roman traveled the granite and limestone highway to Lyon, he could get a drink from earthenware pitchers at a roadside



Polyester chips, used in making yarn at Goodyear's polyester plant near Point Pleasant, W.Va., drop into 25,000-pound capacity blender. Chips are then fed into extruders to form yarn which is later spun into tire cord at one of Goodyear's mills.

stand while his horse drank from a fountain.

Unfortunately for the modern Vienne townspeople, the ruins are on a site that had been designated for a badly needed school. National publicity persuaded the city to accept half a million dollars for the trouble of building the school on an adjacent site.

The only problem is that archaeologists are still excavating the ancient town, looking in particular for a stadium mentioned by Pliny the Younger, a Roman author and administrator of the first century. What if it turns up beneath the new school site?

Artificial limb was designed for French racehorse, Audace, after an accident required that one of her legs be amputated. Horses are usually destroyed under such circumstances, but recent progress in the designing of artificial limbs gives her another chance at life in the pasture.

Pictorial Parade

Protein from petroleum

Petroleum may be a future source of protein, Mobil Oil researchers say. Using microbes, tiny single-cell organisms, they can make protein out of petroleum hydrocarbons much faster than a steer can produce protein. A 1,000-pound steer can make a pound of protein in a day, but 1,000 pounds of microbes can make 4,000 pounds of protein in the same time. The microbe-made protein contains the same amino acids essential to life that the protein in eggs and meat contains, as well as vitamins.

Mystery mineral found

A mineral unknown in any rock on earth has turned up as minute grains in three iron meteorites that fell on the United States and Australia, says *Science* magazine. Named krinovite after E. L. Krinov, a Russian scientist, the new mineral is deep emerald green. Two U.S. scientists used electron microprobe methods to determine that krinovite is a silicate with a rare ratio of silicon to oxygen in its composition.

No hope for the top

If you want to be president of a big company, stay out of research

and development. That's the advice of Golightly & Co., management consultants. Their new study shows that less than five percent of the men from R & D become presidents of the major industrial firms. Men with financial backgrounds have the best chance at the top job today, followed by marketing men. Engineers come in third.

The trend may change, though; marketing personnel used to account for 29 percent of the presidents—now they're down to 18 percent.

Gulf depths yield oil

Oil has been found two and one-half miles below the floor of the Gulf of Mexico in what may be the deepest underwater deposit ever discovered. Until now, oil has been located only in the shallow waters of the continental shelves. The oil was found in a core taken from the Sigsbee Knolls, salt domes often associated with oil deposits. The oil and the salty mounds indicate that the Gulf may once have been smaller, says Dr. Melvin Peterson of Scripps Institution of Oceanography, which made the discovery.

LSD in Middle Ages

The first recorded LSD trip may have taken place back in the Middle Ages. A mysterious malady called "St. Anthony's Fire" that first appeared in 944 A.D. is actually the result of people unwittingly eating an LSD-producing fungus called ergot, claims author John Fuller in a new book. The symptoms of the "Fire" include hallucinations similar to those of LSD trippers. Fuller's book, *The Day of St. Anthony's Fire,* describes an outbreak of the malady that afflicted 300 people in a French town in 1951. Doctors have not yet ascribed a cause to the epidemic.

Volunteer airmen enter 300-400 degree F. ovens for periods up to 15 minutes and come out unscathed except for blisters on ears. Tests conducted at Wright-Patterson Air Force Base, Ohio, to enable pilots to predict times of useful consciousness in case of thermal emergencies.

BIPS

Talking binoculars run on batteries contained in small box between eyepieces. Connect headset and point toward person similarly equipped up to half a mile away and talk. Made by Signals Research and Development, Christchurch, England.

Device (top left) containing radioactive material is now available to high schools. Test samples are placed in 3-by 4-inch irradiation chamber of the Gammator 50. Made by the Radiation Machinery Corp., 1280 Route 46, Parsippany, New Jersey.

U.P.I.

Thought-control of artificial arms (left), called the "Boston arm," is demonstrated at Massachusetts General Hospital. Human brain triggers electronics in prosthesis to make it operate (below). See "Amputees 'think' limb control," page 62.

Prism goggles (below) that will allow the skier to crouch, lower his head, and still clearly see what is straight ahead offer advantages during ski competition because the force of wind against upright body hampers speed. From Switzerland.

PIP

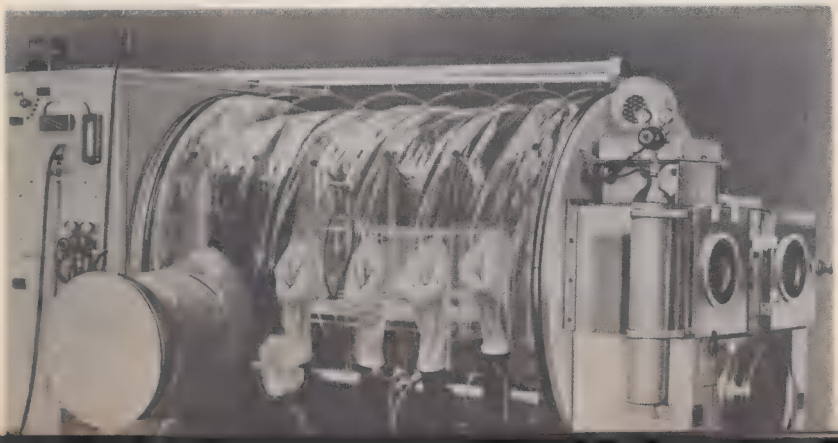
BIPS

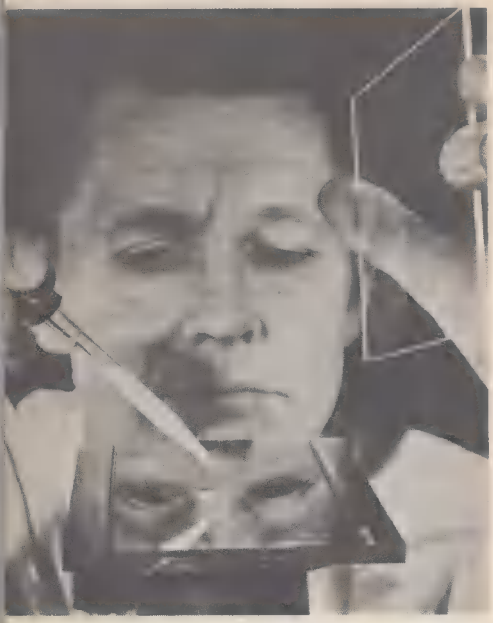
"Drive carefully" slogans have covered all angles in order to put their point across. The latest one refers to the growing search for heart transplant donors and to Dr. Christiaan Barnard, South African surgeon who performed first transplant.

Disposable skin test device (top right) helps detect histoplasmosis, a fungus infection with symptoms similar to a number of diseases. Histoplasmin Tine Test is developed by Lederle Laboratories, American Cyanamid, Pearl River, N.Y.

Smallest mercury light bulb (right), developed by Westinghouse, Bloomfield, N.J., is compared in size to average large mercury vapor bulb used commercially. Bulb has lifespan 12 times greater, is twice as bright, as ordinary household light bulb.

Germfree baby delivery is possible in sterile plastic delivery isolator. Gloved sleeves (shown below) permit surgical team to perform Caesarean section; infant then goes through germfree tunnel to mobil isolator. Portex Ltd., Kent, England.





Liquid crystal drops are squeezed onto glass plate. With other glass on top, electricity will make it frost, form images.

Liquid crystals

IN THE FUTURE you may be able to see a clear television picture on a sunny beach, read your automobile speedometer in any kind of light, own a wristwatch without moving parts and frost your windows by pushing a button. The products are all suggested applications of liquid crystals. Research on the subject is being carried on at RCA's Princeton, N.J., laboratory.

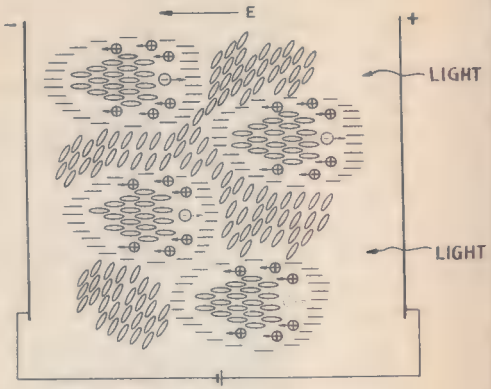
Scientists at Princeton have already built what they call "crude prototypes" of some of the possible applications of liquid crystals, a fairly common organic compound

Images of high-resolution liquid crystal (below) are seen by reflection and grow stronger as light shining grows brighter.

that pours like a liquid but looks (under a microscope) like a crystal. A scientist picks up a small glass screen, holds it to his eye and presses a button. The screen clouds and his eye is hidden. He shines a strong electric light on a faint design and the design leaps out at the viewer. He indicates a panel on which numerals change to keep pace with an electric clock on the wall.

What makes these products "go"? If you examine the devices, you'll see that each one consists of a kind of thin sandwich. The filling is liquid crystal. The bread is two glass plates covered with a conductive coating. When a charge is applied to the sandwich, the crystal clouds, an effect that disappears as soon as the charge is removed. By shaping the coating in various patterns, you can produce letters, symbols or other images. To display motion, you lay down a mosaic of coating elements which can be charged separately.

RCA is concentrating on "ne-



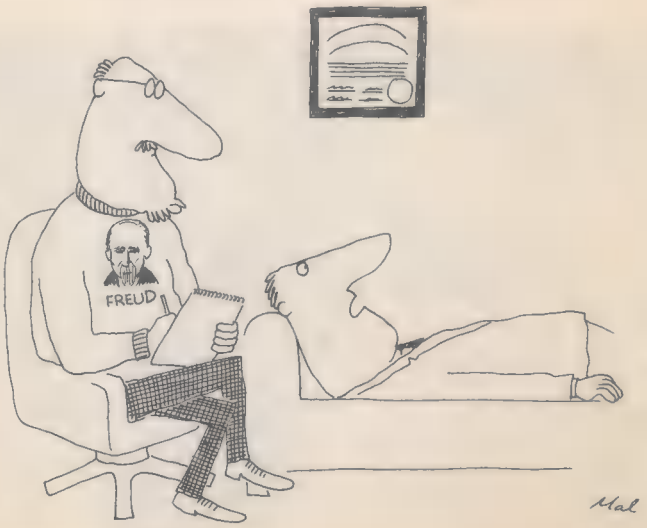
Disruptive ions moving through nematic liquid crystals (above) give normally transparent liquid a white appearance.

An RCA scientist checks old-fashioned wrist watch against all-electronic version using liquid crystal display to show time.

matic" liquid crystals, which have molecules that form into parallel lengths like bundles of sticks. When an electric charge hits a sandwich with this kind of filling, ions are created that travel through the material and scatter light. The scattering effect gives liquid crystals their milky-white appearance. The frosty surface reflects light like a printed page. The brighter the light that is turned on it, the better it can be seen—an obvious advantage in such applications as television sets.

The fact that liquid crystals cloud when an electric charge is applied has been known for some time, but until recently, the effect only worked at high temperatures. It took RCA scientists three years to come up with a compound that clouds at temperatures from below the freezing point to the boiling point of water. RCA is keeping the formula for the compound a secret, but its major elements are believed to be carbon, hydrogen, nitrogen and oxygen.

Liquid crystal applications are lightweight, need little power and last up to 3,000 hours, RCA points out. What's more, they're cheap. When will they be ready for the market? RCA isn't sure. Some of the simpler applications—such as the cloudy screen—are almost feasible now. But the television screen still presents formidable problems, principally because of the large number of integrated circuits needed to power it.



Thermogram shows variation of temperature in facial tissues. Dark areas of ear, cheek and nose indicate lower temperature.

SCIENCE DIGEST SPECIAL

Heat photography—new tool for science

Thermography is a new scientific tool that promises to be a panacea for everything from detecting cancer to blackouts.

by **Jeanne Reinert**

A FOREST FIRE blazes out of control, destroying miles of wilderness. A husband's lonely vigil ends as his wife dies of breast cancer. Millions of people are plunged into darkness as a power blackout sweeps across several states. Unrelated though these catastrophies

Man is hidden in the underbrush of forest (top), but can't be detected by ordinary photograph. Thermogram (bottom) spots figure because natural body heat makes him stand out from his cooler environment. Warm areas are light; cool areas are dark.

may seem, they share a common hope—a unique new process that may bring relief to all of them.

The process is thermography, a phenomenon that can spy a camouflaged soldier hidden in a jungle, help pinpoint frostbite, analyze moon craters, warn of incipient forest fires, cancer and power blackouts.

Still in its infancy, thermography senses heat patterns and displays them as still or moving pictures. Such heat patterns are called thermograms. They represent the temperature profile of the subject rather than its visible image. Scientists are able to interpret these heat maps into useful information, often more detailed than can be found with other methods.

Actually, theromography is a branch of infrared radiometry (*Science Digest*, Nov. '67). It measures and records the infrared waves emitted naturally by the subject.

The underlying principle is one of sensing waves. If you look at a

hibiscus flower in front of ferns, you see bright reds and cool greens. Actually, you are sensing energy waves of visible light. Each color has an exact wavelength and waves of different lengths appear to us as different colors. The color red has the longest visible wavelength. Exactly the same type of wave, but with a longer wavelength and a lower frequency, is called infrared. We cannot see infrared waves, though they are all about us. We can, however, feel the energy these waves produce as heat.

Infrared energy

All objects seek to come to a common temperature in relation to each other. Thus, ice newly placed in a glass of tea melts as the tea gets colder. If the glass stands for a little while, the ice melts completely and the tea chills. Left standing longer, the tea warms until it reaches the temperature of the room. The room, in turn, is minutely cooler due to the chill that the glass of tea lost to it. All of these things give off infrared energy in proportion to their temperature. The radiation is continually emitted, absorbed and reemitted by all objects as they exchange heat.

Some things absorb a lot of infrared energy. Non-reflecting surfaces, such as skin, fall in this category. The interesting thing is that all objects emit energy in amounts equal to the infrared energy they absorb. This characteristic makes it possible to measure the amount of emitted infrared and correlate it with the object's temperature. This information is then transformed into a heat map or thermogram.

This is accomplished by the thermograph instrument, which collects infrared waves through a lens as they are emitted from an object. This information is then converted into proportional electrical impulses, which are shot through an electron gun to the inner face of a cathode ray tube in a continuous stream of black and white signals, exactly like a television screen. The result is a "heat picture" of the subject—a "contour map" of its various temperatures. Black connotes the coldest areas and white the hottest areas. Shades of gray display temperatures that are in-between. The range of temperatures depends on the specifications of the particular thermograph. For example, one type of thermograph can measure from 5° F. to 122° F. With this range, the thermograph is exact enough to show temperature differences of one-third of a Fahrenheit degree. A machine like this is excellent for medical diagnoses. Another can show less exact differences, but may have a wider range of temperatures. One such machine measures temperatures from −20° F. to 362° F. Temperature differences would be exact enough to inspect air conditioning systems.

There are two basic types of thermograph machines. One produces the real-time picture, quite similar to live TV broadcasts. The pictures appear on the cathode-ray tube as

Smoking temporarily lowers temperature of extremities because of blood vessel constriction. Thermogram indicates temperature drop by showing hands as light before smoking and progressively darker after cigarette. Recovery takes 105 minutes.

the subject moves. For example, the progress of a fire might be followed as it burns and as it is put out. The picture can be monitored as the action occurs. Movies of the heat action shown on the cathode ray tube can be taken simultaneously if a record is necessary.

The other type of thermograph is similar to a snapshot camera. Thermograms on this type of equipment can take from 15 seconds to four minutes to expose, depending on the machine used. The subject must remain still for the duration of the exposure. This thermograph is used to take pictures of such subjects as stationary rocket cones and human anatomy. Photos of this thermogram can also be taken to keep a permanent record. Otherwise the "heat picture" is simply erased from the screen by pushing a button, like a magic slate.

In one new system, the AGA Corporation of Sweden turns each temperature into a specific color by using filters (see cover of this issue). An actual temperature reading (represented by different colors and shades), appears for every section of the subject. This is more exact than black and white and is considerably easier to interpret.

A heat map by itself does not sound too exciting. But what can be learned from such a map?

Imagine you are standing guard over an ammunition dump in the jungle. The night is cool and fog blankets the trees. Your eyes strain to detect the whereabouts of enemy troops—to no avail. You know that, even without the fog, camouflaged men may be upon you before you can react. But train a thermograph "camera" at the fog-draped jungle, and the 98.6° F. temperature of a human will stand in stark contrast to the cool surroundings. All the camouflage the person can don will not disguise his body's warmth or location (see photos on page 36). That's one use of a heat map.

Although the military is the big-

gest user of thermography today, little is known of such uses since most are classified. But it isn't hard to imagine valuable applications in that area. Clearly, a thermograph could be pointed at the cold reaches of space. As soon as an enemy rocket, missile or jet streaked across the sky, tailed by their plumes of heat, a thermograph could locate them.

People running airlines, air-conditioning firms, space research and power companies have welcomed thermography. It allows them to find out how their equipment is operating without having to tear it apart for a visual inspection.

For example, Scandanavian Air Systems estimates that 50 percent of maintenance time devoted to airplanes is spent just "looking." Thermographs can scan honeycomb structures and pinpoint areas where heat is building up or being lost more rapidly than in the rest of the material. Localized heat loss or buildup in a honeycomb structure may indicate a structural flaw.

In cold weather, iced-over glass windshields court disaster. This hazard can be overcome by imbedding transparent electrical heating wires in the glass. The windshield is thus kept warm—at least until a wire fails. In airplanes, these wires are tested, usually by measuring electrical resistance. The thermograph, however, shows faults earlier and more completely. Pittsburg Plate Glass Company has experimented with electrically warmed windows, and some 1969 cars, especially fastback models, may have a warmable window, pre-tested by thermograph.

Many major power failures, such as the blackout that blanketed 15,000 square miles in New Jersey, Pennsylvania, Maryland and Delaware last year, have been ascribed to underestimated power demands. Today, power lines in more than 50 percent of the states are surveyed via thermographs. The units are mounted in trucks which cruise along streets while a user looks along the lines for hot spots revealed on the thermograph screen. Such spots may occur at faulty points of connection, and in overloaded resistence components—like transformers. Bushing studs on out-

door capacitor banks may burn, bushing wires may corrode and overheat, the insulator clamp that protects a wire joining can get hot enough to melt inside. All such hot spots show on the thermograph before trouble brews. Repairs can prevent catastrophic disruptions.

One utility thermograph is mounted in a helicopter which cruises above power lines in mountains and unpopulated areas, checking 200 miles of transmission lines a day. By such inspections, power companies aim to prevent not only major blackouts, but even the small area blackouts affecting 30 or 40 houses.

An insurance guage

Last July in Rhode Island, 1,000 oak whiskey casks, each filled with 25 gallons of alcohol, went up in flames, filling a warehouse with smoke and fumes. Water sprinklers were touched off and firemen poured more into the billowy inferno. Before the fire was put out, total loss occurred.

This particular fire was planned. The firemen were on hand before the match was lit. The people lighting the fire were paid to do so. Their job is to analyze fire-fighting equipment and the fires themselves for Factory Mutual Research Center, the research arm for a major industrial insurance company.

The center maintains two labs for the express purpose of setting fire to clients' wares in order to gauge the insurance risk. Of course, once the sprinklers and hoses begin to play water on the fire, smoke billows. "The whole picture is obscured," explains Dr. Russell Pierce, head of the center. But a thermograph can see through the smoke and water vapor, detailing the course of the fire and its temperature. Although Dr. Pierce has been setting fires for some time, he's only had the thermograph to study his most recent experiments. Before that, he had to use thermocouples, which often would be oxidized by the heat. They gave unreliable and fragmentary heat readings. With the thermograph, Dr. Pierce has been able to direct the firemen with infallible precision. ("Hey fellows, it's still burning over there.") The thermogram invariably will reveal hot spots ready to burst into flames anew.

Any item (from plywood to solar cells) that is glued, welded or otherwise bonded in layers can be checked for flaws. The method for finding structural flaws begins with warming the item a few degrees above the ambient temperature. The heat flows through the article evenly. If the bonding material has skipped a spot, the heat is trapped and cannot continue to flow outward. It begins to flow in other directions. Thus the unbonded area forms a cool oasis in the middle of a warmer-than-normal area, showing up as a dark blot on the thermogram. If glue has piled up in an area, heat is forced to travel more slowly through the bulk, and that causes a light colored hot spot

on a thermogram. Thus, any bonded material can be inspected for flaws. Any layered product like plywood, insulating rock wool and electronic circuits can be inspected with a thermograph by this simple process.

Thermal pollution is a recent worry that is now being explored via thermography, according to Nathan Buitenkant of Barnes Engineering Company. Such pollution is generated by nuclear power plants. The Indian Head, New York, nuclear plant, for example, killed tens of thousands of fish with the hot water it dumped into the river when the plant first opened. Rivers, of course, are influenced by tidal currents and multiple other factors. No one really knows what all of the heat effects are. Mr. Buitenkant expects that heat maps will reveal new facts about the patterns and effects of thermal pollution in our waterways.

Thermography has been successful is solving research questions in space and in inspecting solar cells before they are launched into space. The NASA Center in Cleveland, Ohio, builds two-layer solar cells. In a room filled with artificial solar light, the cells perform as they will in space. The fake solar light produces an electric current between the two layers. Any short circuits are visible on a thermograph screen as hot spots.

What causes the hot spots found on the Moon's crater Tycho? That problem confronted Dr. John W. Salisbury and his associates at the

Thermograph is used by Swedish State Power Board to inspect electrical power systems (top). Areas of trouble can be pinpointed before they can develop. The higher temperature of the electrical resistance (bottom) stands out as very light.

Air Force Cambridge Research Laboratory in Massachusetts. The researchers knew the crater was hot, but did not know if the heat came from within the moon itself. If the

Hot areas in this rear engine car show up lighter. Notice also that its occupants stand out because of their body heat. Car manufacturers may use the thermograph to detect structural or electrical flaws in production.

heat were internal, it must result from volcanic action within the moon. On the other hand, if the heat was reflected from the sun, the crater more likely resulted from a collision with a meteorite.

The researchers turned their specially-designed Barnes thermograph skyward across the 240,000 miles of space and focused on the crater. The information they collected indicated that Tycho's heat was reflected, supporting the idea that the crater resulted from a meteor impact.

Another unusual research problem bothered conservationists. These men wished to increase the size of a flock of wild ducks. They hoped to accomplish this by introducing ducks bred in captivity into the wild flock. The wild ducks would only consider accepting the newcomers if they followed the same behavior patterns. Query: What do wild ducks do at night?

Do they eat, sleep, take turns standing guard, seek companionship with other ducks? Throwing a light on the ducks was not the answer. Even slight illumination might alter the wild ducks' nightly rounds. So the scientists used a thermograph to follow the ducks in darkness, letting their own body heat record their movements on film. That study is still underway, conducted at night from a small boat. With the information they acquire, the men hope that ducks can be bred in captivity, and eventually become an integral part of the wild duck flocks.

The medical applications of thermography are based on the importance of human body temperature at various places. The time-honored thermometer gives only one localized reading. Specific readings have been possible with electrodes, but each electrode wire requires relocation for a point-by-point study. A thermograph, however, will measure temperatures at all points of the body in each picture taken.

You might think the temperatures would only reflect the skin

surface temperature; that is not the case. Underlying warmth or chilliness comes right through the skin.

Every mother knows that if she feels any part of her child's body—forehead, arm or tummy, when the child is running a fever—any extra internal warmth is noticeable right away. This characteristic is used thermographically to isolate local internal inflammations and locate their limits.

Skin that is inflamed, swollen or situated directly over veins, infections and bruises will appear hot. Skin over areas with a small blood supply (for example, knuckles and knees) will be cool. A thermogram of the body will reflect blood circulation and abnormally warm areas. Physicians can study a thermogram, therefore, and see the areas that do not show a normal pattern of hot and cold.

Anyone with a sprained or swollen ankle knows how hot it feels. Injured tissue is warmer than the surrounding unharmed tissue. Before thermography, however, these known differences were too subtle to utilize to a patient's advantage. In 1951, for example, two Britons, Drs. R. W. Lawson of the Royal Victoria Hospital in Montreal and K. Lloyd Williams of the Middlesex Hospital in London, discovered that skin temperature over a breast cancer was a degree or two Centigrade higher than over noncancerous tissue. But no practical way was found to put this information to work.

One of the most exciting medical applications of thermography uses this knowledge. The use is an attempt to devise a screening process to locate breast cancer. Dr. Jacob Gershon-Cohen, professor of radiologic research at the Albert Einstein Medical Center in Philadelphia, has used thermography, in conjunction with other methods, to try to pinpoint breast cancer before it advances too far. To date, more than 5,000 women have been thermographed. If a breast cancer can be found while it is still tiny, the cancer has seldom spread to other parts of the body. Dr. Gershon-Cohen and others working in the field hope thermography can be refined into a simple, reliable breast cancer screening process for vast numbers of women. If they succeed, breast cancer may not be able to claim the 500 victims per week it now kills.

Boon to medicine

Thermography has many other medical uses. It can diagnose fractures, sprains and severe bruises. In a bone fracture, for instance, the area may remain hot for the same length of time that the fracture continues to pain the patient.

Lack of circulation in frostbite shows clearly on a thermogram. Frostbite deadens tissue. The line between dead and living tissue is black and white on a thermogram. Such information enables the surgeon to remove all of the frostbitten area precisely.

Burns also register clearly. The more serious a burn, the more the blood vessels vary from a normal

Cancer can be detected early because of thermography. The temperature of cancer tissue is slightly higher than normal tissue; this heat shows up as lighter on thermogram. This woman is suffering from cancer of her right breast.

pattern. In addition, the center of the burn will be the most inflamed. As the burn radiates toward normal tissue, the inflammation subsides. These hot and warm regions show up on a thermogram and indicate how serious the burn is. Thermograms can be taken as a burn heals, and will show healing progress. The beauty of thermography is that nothing has to be applied to an already painful burn. The thermograph simply measures the temperature without touching the sore surface.

A recent Gershon-Cohen study of the effect of smoking cigarettes underscores what doctors have long suspected: Smoking causes the fingers and toes to become cooler by reducing the size of the blood vessels and impeding normal circulation. The study reports that a pack-a-day smoker, a healthy man of 68 years, had the normal temperature of 89.6° F. in his fingers (fingers and toes are cooler than the torso). It dropped to 86.0° F. after smoking. One cigarette caused his circulation to be altered for one and three-quarters of an hour. Studies such as this one will give new insights on the controversial effects of smoking.

Plainly, thermography has a great future. Like the laser, refinements and experimentation will make it more and more useful. There are limits, however, and some of them welcome.

Recently a customs official read about thermography and dreamed up a special application. He wanted to spot smugglers. He knew the stress of going through customs checks would cause smugglers guilt. He hoped the guilt would cause their temperatures to skyrocket. He planned to locate a thermograph so that all passengers would walk past the machine and their temperatures could be read. The smugglers, nervous and hot, would be spied and their belongings thoroughly searched for the contraband. To his regret, it wouldn't work. So at least one Orwellian suggestion was squashed before it could become a "Big Brother" reality.

How color thermography works

While each thermograph maker has features unique to his equipment, units operate in the same basic fashion. Most recent milestone is the color unit designed by engineers at the AGA Corporation in Stockholm, and the Swedish Defense Research Institute. Here's how it works.

Two main components form the basic system. One is an infrared camera which scans the object. The other is a modified oscilloscope which displays the heat map.

The camera operates on the same principle as early TV systems. The subject stands in front of it and the image is picked up in a concave mirror. A plane mirror moves back and forth, scanning the curved mirror from top to bottom. An eight-sided silicon prism scans from side to side as it revolves at 200 revolutions per second to provide the heat map image.

The heat map is divided into 100 lines with up to 100 discreet spots in each line. A detector of indium antimonide, which must be kept at the temperature of liquid nitrogen (−320.4° F.) turns the radiation from each picture element spot into an electronic signal. The picture is built up by these signals, synchronized just the way an ordinary television set is. About 160,000 information bits are converted each second. The picture is transmitted at 16 frames per second, the same speed as a movie camera. This presents a picture in continuous motion on the five-inch cathode ray tube screen.

Two controls are provided so temperature range and level can be varied as desired. The temperature range will identify temperatures from 5° F. to 122° F.

Color thermograms are built up with each color and shade representing a specific temperature. Violet, for example, may correspond to a temperature of 69.8° F.; white, at the opposite end of the scale, to 95.0° F.

The adaptation to color from black and white thermograms was devised by isolating each specific temperature. The area of a particular temperature—a particular shade of gray—is isolated on the screen. Then this shade of gray is converted to a white area. A photograph is taken on color film through a color filter selected to correspond to the temperature. The same frame of film is exposed nine different times, each time with specific temperature pattern isolated on the screen. For each exposure the filter selected to go with the particular temperature pattern is exposed. It takes 15 seconds to build up a heat map in color.

Australian News and Information Bureau

The vanishing bandicoot

THE PIG-FOOTED bandicoot, an Australian marsupial whose Latin name is regarded as a joke in scientific circles, is faced with a fate that is no laughing matter. It, like numerous species all over the world, is about to become extinct.

The bandicoot or bilby was probably a rare species even before the arrival of Europeans in Australia in the 18th century. It was certainly not common when the species was discovered by Surveyor General Major Mitchell in the Lower Murray River country in 1836.

The bandicoot Mitchell first encountered was a curious-looking creature without a tail. It had two-toed forefeet and solid-toed hindfeet. He sketched the animal, and his drawing was used by the naturalist Ogilby who gave it the specific name of *Chaeropus,* or hog-foot, referring to the forefoot structure, and the name *ecaudatus* because it had no tail. This is what made scientists laugh.

The animal that Mitchell used for his sketch obviously had lost his tail through some accident. Because when Gerhard Krefft, then the curator at the Australian Museum in Sidney, asked his aboriginal guides to find an animal like the one in Mitchell's drawing, they went out and caught numerous common bandicoots and simply pulled the marsupials' tails off.

Naturalists stopped chuckling, however, when they realized that the bandicoot was steadily diminishing in numbers.

Colonization of Australia had a lot to do with the decline of the bandicoot, but it was not the only cause. Australian mammalogist Ellis Troughton says, "The habit of sheltering in timber, as with many other marsupials, left them prey to bushfires."

Perhaps the most significant cause of this animal's decline has been the English fox. Introduced into Australia to provide sport for homesick British immigrants, the fox has played havoc with many small marsupials. In some areas the bandicoot is gone forever.

Whales are the largest animals ever to live on earth—larger than elephants, even prehistoric dinosaurs. The food potential from such an animal might help solve the world's increasingly critical food shortage—if whales could be "farmed" successfully like cattle.

Whale farming in a coral corral

Booming populations demand that new food sources be developed. Man has domesticated other animals. Why not try the largest of all?

by Kevin V. Brown

How do you like your whale steak—rare or well done? You may have a chance to find out. If so, your choice cut may someday come from a whale "farm" far out in the Pacific Ocean where the mighty mammals could be bred and fattened up for eating in much the same way that cattlemen raise beef on the hoof.

While whale meat may not become a standby on American dinner tables, it may well be an answer to the world's rapidly worsening food shortage. With many underdeveloped and overcrowded regions already facing near famine conditions, a fresh, new source of food is urgently needed. Whales may be that source.

A plan to establish whale farms in the Pacific, using circular coral atolls as natural pens or corrals, is exciting serious interest. Fenced in by rings of coral, the whales would breed and graze contentedly, growing plump for later slaughter. The proposal was made recently by Professor Gifford B. Pinchot, a biologist for the Johns Hopkins University, Baltimore, Md.

"We still hunt, rather than farm the ocean," he argues.

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In its simplest terms, his plan goes like this. It has its roots in the fact that all life depends on using energy from the sun in photosynthesis to convert inorganic nutrients into organic food-stuffs, a process carried out by plants on land and in the ocean.

"All the rest of us," he says, "those who are not capable of photosynthesis, live either directly or indirectly on these plant products."

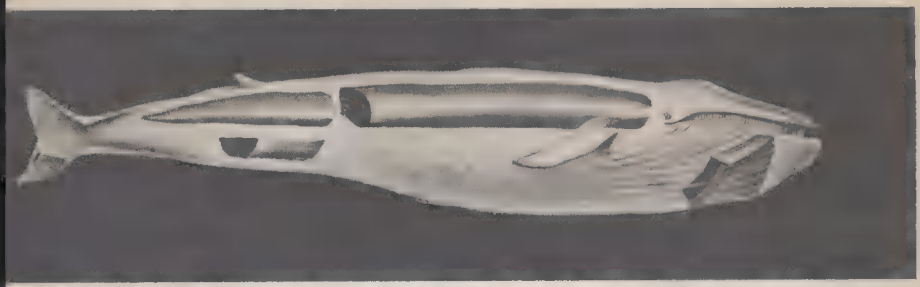
And Prof Pinchot goes on, oceans cover almost three-quarters of the surface of the earth, so they receive roughly three times as much sunlight and are potentially three times more capable of food production.

GRAZING WHALES, corralled in shallow lagoon of Pacific atoll, would be kept in by "fence" of coral. How whales eat is key to plan. Bristle-like network, called baleen, traps plankton—tiny marine creatures—which is all baleen whales need. Nutrient-rich deep water, pumped by simple windmill power into lagoon, promotes growth of plankton, which is fertilized from boats in lagoon and photosynthesized by sunlight

So "farming" the ocean would involve seeding, fertilizing and harvesting it just as we do the land.

Enter the whales. Prof. Pinchot chose whales for the obvious reason—they're the biggest mammals that ever lived—but for other reasons that conservationists and sociologists would applaud. They've been hunted almost to extinction and could use some help from man to survive. Also they are a great source of animal protein.

Not only is the world's food supply dwindling in relation to its expanding population, but even in areas where food is available, there's a shortage of animal protein, and some sources blame half the deaths of children between one and five in



One blue whale equals more than 20 large steers or about five tons of edible meat. The dark areas in the drawing indicate the most desirable parts of the whale. The cylindrical area alone represents about 7,300 pounds of meat, protein for quite a few.

underdeveloped areas on the lack of animal protein.

But how do you domesticate a whale in the same way as a Hereford steer? Prof. Pinchot's plan is to use tropical lagoons in the center of coral islands. These islands are actually the tops of extinct underwater volcanoes, so the area within the ring or lagoon is relatively shallow, and the openings could be closed off by underwater fences. A coral corral.

Whales, like any other animals, have only two basic needs: food and the propagation of the species. If they're content, they'll take care of the propagation themselves, and food will be the only problem. Just as the farmer brings feed to his livestock to fatten it, the whale farmer would have to do the same. And we're back to photosynthesis.

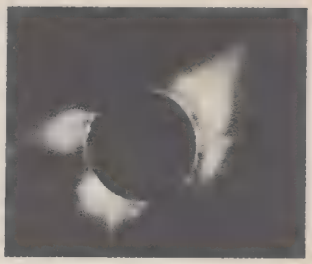
Most whales, notably the blue, humpback and sei species, live almost entirely on infinitesimal plants and creatures called plankton. Killer and sperm whales are carnivorous, so they could not be raised under these conditions.

Tropical waters are rich in inorganic nutrients, but not at the surface. Pinchot would draw nutrients from deep outside the coral reef, perhaps with windmills, and pour them into the coral corrals where they would be fertilized by man, photosynthesized by nature and consumed by contented whales.

Whales used to be hunted for their oil with their meat as a lightly regarded by-product. Now, however, with other, less expensive sources for oil, whales are looked to more for their meat.

Capturing the whales initially would not be a major problem, although the logistics would be whale-sized. They could be drugged and towed to the corrals. Hopefully, after that nature would take its course and the whale population would increase in size without any help from man. At slaughter time, these chores could be carried out on shore facilities on the corral ring or, as they are done now, on whaling ships.

Is yours the special kind of mind that has to know...



. . . what causes the sun's coronas—both near and far? What curious phenomena they create in Earth's atmosphere? What part the sun plays in the five ways the world may end?

. . . that the world's smallest monkeys—pigmy marmosets—are the size of mice, weigh a few ounces, are talkative, snippy.

. . . how computers are programmed to draw pictures? How sketches like the one here, drawn by an electronic brain in London, was a key tool in solving problems in a study of human factors?

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WSD8L1

NEW FOR INDUSTRY

Technician bathed in simulated solar radiation (above) checks output of 120-kw solar simulator developed by Genarco, Flushing, N.Y. The 130-mm diameter carbon arc which irradiates very large area developed by Union Carbide, N.Y., N.Y.

Torpedo-like underwater meter reader (below) is being checked by diver from Marine Advisers of La Jolla, Calif., subsidiary of the Bendix Corp. This modern tool for exploring the sea depths records the speed and direction of ocean currents.

Pictorial Parade

Aluminum hemispheres (below) will house electrical equipment controlling propulsion system of Navy's Deep Submergence Rescue Vehicle (DSRV-1). Forged by ALCOA, Cleveland, Ohio, and parts machined to final dimensions by Jay Em Co., Cleveland.

New leak test method (below) uses Ultrasonic Translator detector developed by Hewlett-Packard Company's Delcon Division, Mountain View, Calif. Model extends sensitivity to detect leakage rates of .002 atmospheric cubic centimeter per second.

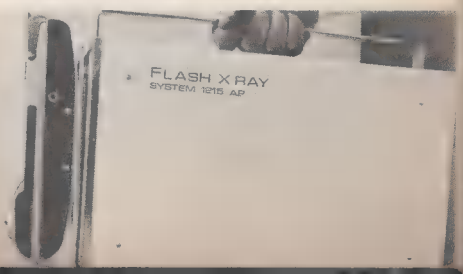
Fresh water is "squeezed" from this brackish pond (above) by portable 100-gallon-a-day reverse osmosis water system developed by Gulf General Atomic, San Diego, Calif. Unit requires tiny gas engine or electric motor to operate; draws water through cellulose acetate membranes.

U.P.I.

Fire fighting in Vietnam (left) currently involves helicopter "fire trucks" that use 450-gallon Fiberglass "aerial fire buckets." When full, the bucket weighs 4,000 pounds, and it can douse a 120x30-foot area. Developed by U.S. Forest Service.

BIPS

World's first portable, self-contained X ray unit (below right) weighs only 25 pounds, measures 16x10x7 inches, is designed for medical, industrial use. Radiograph (below left) was produced in only 20 seconds. By Hivotronic Limited, Wella Road, Basingstoke, Hampshire, England.



Drawings by Robert Jackson

Simian society

Behavior patterns of groups of monkeys have surprising similarity to human social behavior. Monkeys even have a social hierarchy.

by Joseph P. Coogan

We stood in the shed before a wide window, watching the troop of 26 monkeys as they moved together through the wooded enclosure. They were large, formidable pigtail monkeys (*Macaca nemestrina*), and they were going through the normal activities of the troop: grooming, nursing, playing. Then, from nearby, came the sound of a tractor starting up. A big male quickly climbed the tall trunk of a dead tree, sat on its top, and began shaking it quite vigorously.

"That's Quan, the number one male," psychologist Irwin Bernstein said. "He's doing his job of guarding the troop against whatever danger that tractor may represent. But he's also, I think, showing off a little, reminding the others he's the boss. They may need some reminding. He's only been in complete charge a few weeks."

"What happened to his predecessor?"

"Quan killed him. He'd challenged him to several fights over

the last few months, and Earl—the old leader—finally died of infected wounds."

I was visiting Dr. Bernstein at the field station of the Yerkes Primate Research Center of Emory University. The center itself is in Atlanta, Ga. The field station—whose simian population consists of 150 monkeys and 15 apes—is some 30 miles north of the city in an area of small farms and forests. Here, Dr. Bernstein is conducting what might be called sociological studies of three groups of monkeys, each of which inhabits a fenced-in 100-by 100-foot compound.

Part of one fence in each compound is formed by the side of a large metal shed, not unlike a truck trailer, whose interior is divided by iron bars into two sections: one, occupying about two-thirds of the shed, is an indoor quarters for the animals, who can enter and leave at will through small swinging doors; the other, which has room for a few chairs and tables, serves as an observation post.

This society of pigtails is a normal troop that has been together for five years. The other two groups Dr. Bernstein is studying—one of adults, one of adolescents—contain animals of different species: pigtails, spider monkeys, green monkeys, capuchins, rhesus and (in the adolescent group only) hybrids.

"These pigtails are a sort of control group," Dr. Bernstein said. "The data we obtain from this normal society can help us interpret data from the other two."

"But how normal can any society of captive animals be?"

"Their environment is almost the same and their way of living seems exactly the same as it would be in the wild," said Dr. Bernstein, who had spent 18 months studying troops of macaques in Malaysia. "I'm not sure of one thing, though. Long before Quan's final fight with him, Earl had stepped down to take a subordinate position. But a number of the older females still clustered around Earl, while the younger ones went with Quan. So Quan's authority wasn't clear-cut. In the wild, I think the troop might have split—Earl and the older females going off one way, Quan and his followers going another. But of course that's impossible here."

After leaving the pigtail group,

Reprinted with permission from SK&F Psychiatric Reporter © 1968.

we visited the enclosure containing the adult monkeys of various species. The difference between this group (also formed five years ago) and the first was immediately apparent. The animals, spread out over the entire compound, did not move together as a troop, but at random, either alone or with one or two others.

"All primates are social animals, of course," Dr. Bernstein said, "and our purpose here was to see if this mixed group of monkeys would form a coherent social organization. They haven't. The problem to a great extent seems to be one of communication. Monkeys don't have a language in the linguistic sense, of course, but each species has its own communication system—the same repertoire of threats, submissive gestures, sexual presentations and so forth. Now the questions were these: Would the different species understand each other? Would they adopt a common social system, and what would it be?"

In the beginning, the new colony was a simian Tower of Babel. One monkey's friendly greeting or invitation to play, for example, might be misinterpreted by another as a challenge to fight. And the fight could be long and bloody, for neither of the combatants recognized the other's signal for surrender.

"But, over several months, they gradually learned to recognize each other's signals," said Dr. Bernstein. "They learned the most important ones first. Signals for alarm, signals showing an animal was likely to attack. Later they learned the less important ones—such as the signal for 'I give up.' What I mean is that it's less important to the fellow who's *receiving* it, though it's quite important to the one *sending* it. But none has yet ever used the signals of another species. Each can understand the other's 'language,' as it were, but can 'speak' only his own."

We now walked to the compound containing adolescent monkeys of various species who have lived together for about a year. To me, except for the obvious absence of adults, this group seemed much like the normal group.

Young play grownups

"They get along very well," said Dr. Bernstein, "and they *have* developed a fairly coherent social organization, although it's not yet well defined. But compared to adolescents in a normal troop, their behavior is somewhat bizarre. See that female carrying a smaller one? She'll get tired of that pretty soon. These young monkeys often explore adult roles—roles they wouldn't be allowed to assume in a normal group. They're more intensely juvenile, play a lot more than they would if there were older ones around. In one experiment, we introduced an adult male into a group of adolescents. As soon as he arrived, even before he became accepted as a member of the troop, a lot of the fooling around stopped."

Will these monkeys of different species continue to evolve an or-

ganized social system when they mature? Will they "speak" a common language, or will each revert to the signals of its own species? And what of the hybrid monkeys? Can these monkeys of mixed genetic background modify their responses more successfully than the others? As infants, they are raised by their mothers. Will an AB monkey with an A mother have A traits, and will an AB monkey with a B mother have B traits? In other words, how strongly does the animal's early environment affect its behavior? (Dr. Bernstein is particularly interested in hybrids. One of the highlights of his Malaysian trip was the discovery that they exist in the wild.)

As we walked around the enclosures, an animal would occasionally lope over, jump up on the fence and call to or reach out for Dr. Bernstein, who would then pet and talk to it. At times he'd let me do the same, at others he wouldn't. Or he would, after a few words of caution. "Amelia's very friendly, but don't get your head too close to her. She loves to grab glasses." Of a large, powerful mandrill ape who's being used in the breeding experiments: "His canine teeth are very sharp and longer than a tiger's. And he's *big*. But he *knows* he's big, and he knows *you* know he's big, so he doesn't have to prove anything. He's one of the most gentle here."

After our tour, as we sat talking in Dr. Bernstein's office, I asked about Quan, the new pigtail leader. What advantages did his job bring?

"No tangible ones. He isn't, for

example, the only one with access to females. Almost all males get to mate, at one time or another, with all the females. And being at the top is a risky business. In the wild, he's got to be the troop's champion against predators. If the troop is threatened, he—working with some other males and perhaps a few older females—will put himself between the group and its enemy, so the rest can escape. If you went into our pigtail troop here and acted threateningly, Quan would get between you and the rest. He'd be very brave, might even attack. If, however, you took everybody out but him and acted the same way, he'd run. So the function of the big male seems not to be merely an instinctive response, but a role he accepts."

The chief male is also responsible for keeping order by breaking up fights within the troop. What, I wondered, did the monkeys have to

fight about?

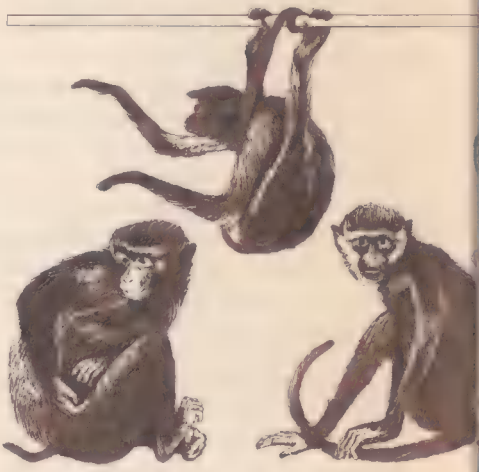
"That's hard to say. They get all they want to eat, and there's a surplus of females. Of course, you realize that most of these fights don't involve physical injury, or even contact. The loser will usually back down or run away before that happens. How do the fights start? Well, a lot of fights start between two youngsters. The females come to the aid of one or the other, and then the males get involved."

"Sounds familiar."

"Another reason a macaque fights is to reinforce his position in a very hierarchical society. He does this by making a token threat or aggressive move toward a social inferior. Sometimes, though, someone who's usually subservient will fight back. And some have made powerful friends who'll do the fighting for them. These monkeys will respond very aggressively when their friends are around, submissively when they're not. Then, too, as a young monkey becomes less dependent on his mother, when he goes out on his own, he'll fight for position. So rank, status, is not absolutely stable. *Why* is status worth fighting for? I'll retreat from that question by just saying it is."

I asked him to speculate on the significance his studies might have for humans.

"Well, I don't particularly like to speculate, but I'll give it a try. Apes and monkeys — chimps especially, but also the others to some degree— are the animals most closely related to man, and you can draw some parallels between their societies and ours. Let's talk about maternal care, for example. Dr. Harry Harlow has shown the results of extreme deprivation of care. But what about degrees of quality? There are good and bad mothers among our animals. What behavioral differences do they show? How do their offspring differ? A study like that could conceivably have some value for humans."



He went on, then, to discuss what he called "one of America's most curious phenomena," isolating old people from the rest of society by placing them in nursing homes or in colonies for the aged.

"People deteriorate somewhat faster when they're cut off from the stimulation of younger generations and of much of society's activities. Now, in the macaque culture, as in most human ones, the aged remain an active part of society. The oldest female in our pigtail troop is the

center of a lot of social activity. Her daughters have remained close to her even after they've had babies of their own. She has a position of great prestige. The old males, too, are well accepted members of the troop. Perhaps, in this instance, we may have something to learn from the macaques."

The "generation gap" is another characteristic of human society that is not found in macaque society,

where the adolescent males—reasonably capable fighters—have well-defined functions. As the troop moves along in the wild, they take positions at its front, sides and rear, ready to fight off enemies.

"Like the big male, they're very expendable," Dr. Bernstein said. "That makes sense, of course. If one or two males are killed, the group won't be greatly affected. But if one or two females are killed, there will be one or two fewer babies the next year."

Adolescent males, who do almost all the exploring for the troop, are more daring than their elders.

"In one experiment we did here, we put a strange, at times frightening, object or animal in a transparent box that could be opened at one end. We then set it down among the pigtails for about 15 minutes—1,000 seconds, to be exact. If it wasn't opened by then, we took it out. We'd put in such things as a toy bear, a monkey doll, a snake, turtle, cat and a German shepherd. We did this a little over a thousand times. They opened the box all but four times. And 96 percent of the times the box was opened, an adolescent male opened it."

Perhaps, then, by analogy, the problems our adolescents have might be lessened if young men had the opportunity to explore new frontiers, to take adventurous jobs.

"I think that's very possible," Dr. Bernstein said. "But those opportunities aren't very common now compared to, say, 100 years ago."

"There's always Vietnam."

"Yes. Vietnam. Actually, you know, most military men will tell you that 18-and 19-year-olds make the best soldiers. Not in terms of leadership—that requires experience and maturity—but in terms of daring and bravery."

Dr. Bernstein does not believe, of course, that studies of primate societies will provide solutions to problems that beset human societies. But he thinks they may help us understand some of the ways these problems arise.

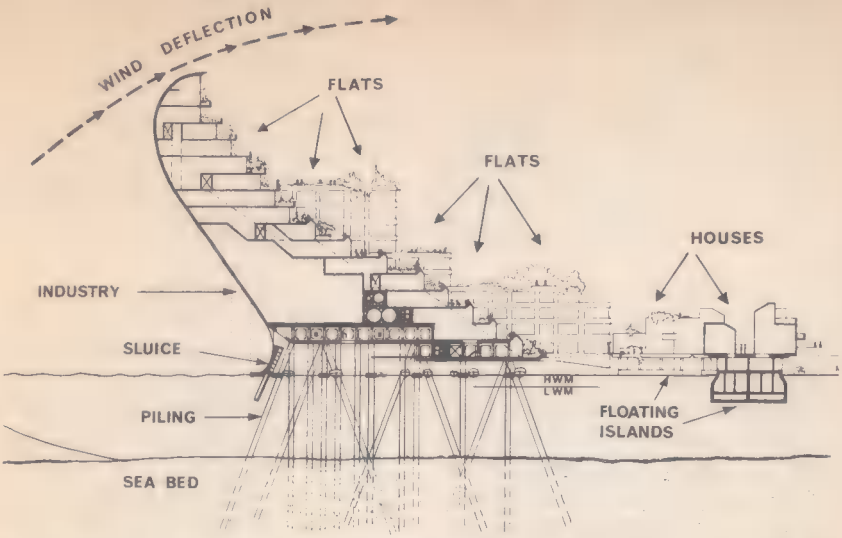
City built on water is a plan for the future designed by a team of British architects and engineers. This model shows how the community of 30,000 would look from the air.

Sea City

WHEN John B. got up, he admired the sea view from his 16th story window before he breakfasted on the outdoor terrace overlooking the lagoon. Descending to the first floor, he walked underneath the apartment building and climbed into the speedboat moored there. He passed an electric boat loaded with commuters bound for the heliport. He threaded his way between islands containing shops and stores, and through an opening in the lagoon. A little while later, he retrieved his car from a shorefront parking lot.

John B. is someone dreamed up for this article, but his watery environment may become a concrete and glass reality some 50 years from now. The mythical John is an inhabitant of "Sea City," a project for 30,000 people that a British firm hopes to build 15 miles off the coast of England in some 35 feet of water. The materials and techniques they'll use are available today. Basically, the project consists of pile-supported concrete and glass apartment houses that form a ring enclosing a lagoon. Floating concrete islets in the lagoon contain shops and schools of lightweight materials.

The cost? No more than a land-based city of the same size, says Pilkington Glass, the firm which came up with the idea. And it will save valuable land space, which will be in even shorter supply in England of the 21st century. Not only that, Sea City will include a highly efficient fish farming industry.



Outer wall of Sea City as shown in this diagram will be of utmost importance. It will rest on completed base and start 30 feet above sea level. Made of joined concrete cells.

The obvious problem involved in a project like Sea City is protection from sea and wind. Pilkington presents a number of ingenious solutions. Surrounding the whole city will be an S-shaped, 180-foot-high wall to deflect the wind. Windows in the wall will give occupants of the eight upper stories of the apartment houses a sea view. Outside the wall will be an artificial breakwater of fabric bags which will cut wave height in half. The apartment houses are solidly placed on piles, while the concrete islets float in the protected lagoon, which is warmed by waste products from industries.

Sea City will be a self-sufficient community in many ways, Pilkington points out. A Sea Cityite like John B. can go to school, shop, work, attend a movie, play team sports and even be cremated without leaving the city. There will be a hospital, medical and dental service, a church, a library, a zoo, an art gallery and a museum. Electric boats will carry passengers to various points in the city, including a heliport where they can catch an airbus to shore.

The power to run Sea City will come from a nearby natural gas field beneath the sea. After processing at a plant within the city limits, the gas will run generators that produce electricity. Water will be provided by a desalination plant.

One of the few ways in which the project will depend on the mainland will be through supply ships which will bring food and other goods. When the weather's unusually bad, Sea City, like a natural island, may be cut off from the mainland temporarily. Ample storage space will see the Sea Cityites through, Pilkington claims. With all its advantages, it may be worth the risk of occasional isolation.

MEDICINE

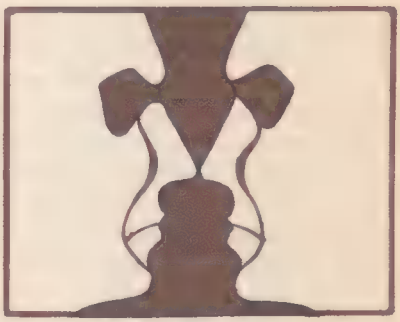
Ten types of patients that doctors deplore

by Arthur J. Snider

THE COMMON COMPLAINT against the doctor is that he is too impersonal, too hurried and harried. He is criticized for refusing to make house calls or not being available when you need him in an emergency.

It may come as a surprise to the disaffected that the doctor is not altogether enthusiastic about some of his patients. "Physician's Management" has completed a national survey on what kind of patients bug the doctor. The 10 most irritating types:

- The inconsiderate patient. Calls nights and Sundays or other unreasonable hours to relate minor complaints, make an appointment or discuss fees.
- The oneupsmanship patient. Knows it all. Deems himself a lay medical authority. Comes in to have his self-determined diagnosis confirmed. Cross-examines the doctor. Is purposely deceptive in his history to add confusion.
- No-pay patient. Rationalizes delinquency on the grounds that all doctors are rich.
- VIP patient. Regards self as privileged. Tolerates no waiting. Expects to be seen as soon as he arrives.
- Perverse patient. Fails to follow instructions. Includes the cardiac patient who complains of not doing well but admits finally he has not followed imposed rules or taken medication. Others are the diabetic who remains fat and the emphysema patient who smokes heavily.
- The medicare misinformed. The patient who insists his insurance and medicare cover everything and refuses to pay non-covered portions.



This also includes the patient who asks the doctor to falsify insurance, disability and medicare forms.

- The invisible patient. Hasn't been in the doctor's office for years but calls regularly to get advice and treatment by telephone.
- Patient's parents. People who have to be elbowed out of the way so that the child can be examined. The mother who brings a youngster with trivial problems. Family members who make excessive telephone

calls about hospitalized patients.

• The tardy patient. Is consistently late for appointments or fails to show without notifying the doctor's office he isn't coming.

• The "red herring" patient. Complaints are not the real cause for the visit.

The obstetrician shortage

Four out of every 10 women who have babies during the five-year period of 1976-1980 will be unattended by doctors during delivery, it is predicted by the chairman of the obstetrics department at State University of New York-King's County Medical Center.

The reason is the growing shortage of obstetricians, says Dr. Louis M. Hellman. Obstetricians and gynecologists comprise six percent of the doctors in the country today and also six percent of the young interns and residents. This means that despite a rising population and more births, there is no growth in the number of doctors.

One solution to the doctor shortage may be the expansion in the ranks of nurse midwives, Dr. Hellman believes. They could serve the doctor in the labor and delivery rooms and in prenatal clinics, relieving him of duties that are not directly concerned with delivery of the baby.

Dr. Hellman questions the widely-held belief that all is well in American maternity wards. Our improvement in infant mortality, an index of good maternal care, has not kept pace with that of several Western countries, he emphasizes.

"No one denies the excellence of our specialists," Dr. Hellman continues. "But the simplistic assumption that our maternity care is good because our maternal death rate is low and because we obstetricians may be doing a good job personally is as illogical as the conclusion that our automobiles are safe because they are pretty and powerful. If we had equalled Norway's 1965 decline in baby deaths, some 25,000 more of our four million babies might have been saved."

Cancer drug at lower cost

A promising drug against cancer, hitherto limited in use because too little could be manufactured and administered, can now be made in larger quantities, at lower cost and in higher purity, according to Dr. Joseph Roberts of the Wadley Institute of Molecular Medicine, Dallas, Texas.

The drug, L-asparaginase, has brought about prolonged improvement in mice with leukemia but has been limited in human trials by high cost ($40,000 for a million-unit dose).

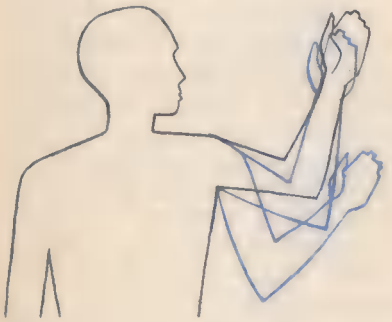
A new high-purity production method allows patients to receive larger quantities in a dose without harmful side effects. Single doses of as high as one million units have

now been successfully administered. This is 20 to 30 times that previously given. In these higher doses, effectiveness in human patients may be achieved.

Amputees 'think' control

A computerized artificial limb that permits above-elbow amputees to "think" it into action like a normal arm has been demonstrated at the Massachusetts General Hospital, Boston. It is not yet available for general use, but its developers say it could be mass produced.

"When a person wishes to move his natural arm, he begins by willing the arm into motion," explains Dr. Melvin J. Glimcher of Harvard Medical School, the limb's chief



developer. "A cell from the brain transmits a signal down the brain stem to the spinal cord and out to the motor nerve which stimulates the muscle. The muscle shortens and the arm or limb moves in the desired way. When the muscle contracts, it gives off an electrical signal. The tiny signal exists in the stump of most amputees.

"In the artificial arm, this signal is amplified and fed through a small computer controlling a battery-powered electric motor which powers the arm into action."

Called the "Boston arm," the new device is said to demonstrate the sophistication bioengineering can achieve. It effects two-way communication with the body through sensing elements which pick up electrical signals from the body and transmit information back to the body. This feedback automatically permits the arm to adjust to increased weights and forces.

One man who lost an arm in an industrial accident was able to learn to use the artificial device in 15 minutes. He said it is much more useful than his cable arm because it can be moved in a more natural, less awkward way.

The arm weighs about two pounds. Electronic components fit inside a flesh-colored Fiberglass casing resembling a real arm. Power is supplied by a small, portable battery which has a six-hour charge. When the wearer is at a stationary location he can simply plug the arm into the nearest 110-volt circuit.

The limb is estimated to have an overall power efficiency of about 60 percent compared to less than three percent for the conventional artificial arm.

By mapping nerve signals which carry impulses from the brain to the muscles, it may be possible to develop a hand with natural char-

acteristics, Dr. Glimcher says, but it will require much more research to obtain a device that can achieve the wide variety of manipulations performed by the natural arm and hand.

Authorities believe the arm could be helpful to most of the 100,000 amputees of the nation and many of the 7,000 children born with deformed arms as a result of their mothers' ingestion of thalidomide drugs during pregnancy.

Regrowing human organs

A Russian scientist believes that human beings someday will be able to regrow organs, making heart transplants unnecessary.

"It is generally believed that the higher vertebrates have irretrievably lost their capacity for any extensive regeneration beyond that such as the renewal of blood normally involved in maintaining life," says Dr. Lev Polezhaev of the Institute of Biological Development in the Soviet Academy of Sciences.

"However, my own research over the past 20 years has shown this is not so. I have found, for instance, that damaged cranial bones can be repaired by the regeneration of new bone. Furthermore, there is the intriguing possibility of causing the regeneration of heart muscle to replace that lost through disease. If this proves to be realistic, it may even remove the need for heart transplants.

In the British publication, "Science Journal," Dr. Polezhaev described how new bone could be grown in the skull with the help of bone dust obtained from a donor. The bone dust is saturated with the blood of the recipient. The same technique could be used in teeth.

Some degree of success has been achieved in both, indicating to him that human beings still possess, in some limited measure, the ability of certain lower orders to regenerate lost claws and legs.

Handling sleepless children

Mothers adopt all kinds of devices to get a crying child to go to sleep. They sit at his bedside, read to him, play games for an hour or two each evening. They lie down at his side until he falls asleep. They take him downstairs again if he cries. They end up night after night taking him into their own bed.

Pediatrician R. S. Illingworth of the University of Sheffield, says this happens most often among mothers who have an only child, who have

had a long wait between marriage and conception or have given birth to a child of one sex after a run of several children of the opposite sex.

He offers these suggestions in handling the sleep-troubled child:

1. Don't pick him up at the first whimper. Children brought up without any stress are likely to find life difficult later.

2. Give him a chance to go to sleep. This is precisely what many mothers will not do. They visit his room frequently and sit with him.

3. Do not take the child into the parents' bed. It inevitably starts a bad habit which will have to be broken later.

4. Don't tiptoe around the house and keep friends away. A child should get used to a certain amount of noise.

5. If a child refuses to lie down when put to bed, he should be left standing as the parents leave the room.

Seven-day hospital week

With patient demand for hospital care at an all-time high in the nation, the question is asked: Why not a seven-day hospital week? The time-worn 5½-day week is costly and inefficient, in the opinion of some physicians.

"There is a bottleneck of admissions on Sunday night, a deluge on Monday, a rush on Tuesday, a steady flow on Wednesday and Thursday, a slackening on Friday and a dead-stop on Saturday afternoon and all day Sunday," contends Dr. Frederick Stenn, a Chicago internist.

"Sickness respects no day of the week. What is so inviolable about Saturday and Sunday? A man with a coronary thrombosis deserves as good care on Sunday as he gets on Tuesday when all services are functioning. What physician does not have an added worry for the patient admitted as an emergency on Saturday night or Sunday with a diabetic coma, bleeding peptic ulcer or acute abdominal condition?

"Why must the physician who on Friday submits to the microbiology laboratory sputum from his gravely ill pneumonia patient wait for a report of polymyxin-sensitive pseudomonas culture until Monday night when his patient has died?"

A seven-day, full-service hospital has demonstrated its worth through actual experience in Camden, N.J. Fifteen surgeons operate at Cooper Hospital on Saturdays and Sundays. Employes work a 40-hour week and have staggered weekend hours, yet the ratio of employes to patients has dropped from 2.22 on a five-day week to 1.89 now. The average census has increased by 38 patients a day. The average stay has been reduced by a half day.

Some physicians object to the seven-day program because of fear that ancillary services such as X ray, laboratory, pharmacy, heart station and dietetic will be understaffed. Dr. Stenn says practical experience has shown this objection to be invalid.

Small children sometimes become arthritics. This little girl's hands are swollen and in danger of becoming painfully deformed. Splints sometimes lessen the deformity.

What can we really do for arthritis?

"Cures" are still in the future, but arthritics can get great relief today from many treatments. This doctor tells what can be done.

by Joseph D. Wassersug, M.D.

As far as the patient knew, he was not allergic to tetanus serum and his skin test was negative, so the doctor in the Emergency Ward gave him a tetanus shot after his accident. One week later he had a bad case of hives, his knees and elbows were quite swollen and practically every bone and joint in his body ached. In spite of the usual precautions, the tetanus shot had caused serum sickness and the allergic arthritis was one of its most troubling manifestations.

I mention this case to point out that arthritis can be an acute illness, that it is not always due to wear and tear, that it does not necessarily cripple. This particular man's arthritis cleared up completely when I gave him an epinephrine shot and some cortisone tablets.

When you mention arthritis to most patients they panic, for fear they are going to be horribly crippled and permanently sick.

Allergy, of course, is an uncommon cause of arthritis. In older persons especially, arthritis is the result of ill-defined factors that can still best be described as "wear-and-tear." Age softens bones and roughens joints. It is our dilemma that if we don't use our joints they stiffen up, and if we do they wear out. To get the best use of our body mechanism one needs a nice balance between rest and exercise.

The arthritis of aging and wear-and-tear is also called *osteoarthritis* or *hypertrophic arthritis*. Unless it affects the weight-bearing joints it ordinarily causes no crippling. The patient who has a little swelling at the furthermost joints of his hands can usually be reassured. He has an osteoarthritic condition called Heberden's nodes that may look ugly but is most often harmless.

When osteoarthritis affects the neck bones it may cause severe pain and disability. The nerves that go to the scalp lead from the neck to the top of the head through openings between the neck bones. When the neck bones are roughened or jagged as they may be through age or injury the nerves are pinched and the top of the head may be exceedingly tender and painful.

Sometimes the pain may extend down the arms to the fingers. Harry L., a 42-year-old paperhanger, was sure he had a heart condition because the pain was in his shoulder and down his left arm. His father had died suddenly of a heart attack at the age of 58, and Harry had read a lot about heart disease. He knew that in angina or coronary thrombosis the pain could be in the shoulder or the left arm.

Harry, however, did not have any pain across the chest. An electrocardiogram, even after exercise, was perfectly normal. An X ray of his shoulder showed no bursitis or arthritis. The X rays of his neck, however, revealed considerable arthritis in that area.

When treatment with aspirin failed to bring relief I advised Harry to get a traction device to use at home. It cost him less than 15 dollars and I gave him detailed instructions on how to use it. With traction the arm pain disappeared. The reason Harry had shoulder and arm pain is that the nerves in the lower neck, those that go to the arm, were being pinched. By traction the pressure on the nerves was relieved, and the pain disappeared.

In the lower back osteoarthritis can be really mischievous. The pain may not be confined only to the back area but may extend down the leg because the sciatic nerve and

other leg nerves may be pinched.

To take the pressure off the nerves I find that the most important first rule is to get the patient off his feet, into bed on a firm mattress or on a bed board. Aspirin, warm packs, heat lamp and massage also help.

In these cases, special corsets may be prescribed, traction may be applied to the leg and the patient given various tablets or intravenous injections to relieve muscle spasm. In some cases, especially if a nerve is pinched by a ruptured disc instead of arthritis, special myelograms (X rays) of the spine may be taken and surgery may be necessary to remove the offending disc. A ruptured disc in the neck may also require surgery for relief.

When arthritis strikes the knees, many different aspects of the problem may have to be considered. First, is the patient overweight? Obesity itself puts added strain on the knees because it changes posture and stance (the patient tends to toe out and waddle like a duck) and because the weight itself traumatizes the joint.

Another question that must be asked is does the patient traumatize his joints in other ways? The housewife who scrubs floors on her hands and knees may unknowingly be heading for trouble. The plumber or electrician who must assume awkward postures and climb into tight spaces may also be setting the scene for knee-joint arthritis.

I find that it is futile to attempt treatment of the knees in an obese person without emphasizing the importance of weight loss.

The first step I take in treating arthritis of the knees is to get the patient into bed and take the strain off his knees. Physiotherapy, including warm packs and massages, is helpful. An elastic compression bandage offers some support when walking is resumed. I do not carry out any cortisone injections myself (although they are definitely of value) but leave such treatments up to an expert orthopedist.

Potential crippler

Rheumatoid arthritis (also called infectious arthritis) is the second most prevalent joint disorder. Although doctors have generally assumed that some germ or virus is its cause, no microbe has actually been isolated from the affected joints so, at present, proof of an infection is lacking. Rheumatoid arthritis may cripple and so it is potentially a dangerous disease.

Since rheumatoid arthritis is a generalized infection it may be accompanied by malnutrition and anemia. A rapid red blood cell sedimentation rate may indicate that the arthritis is still active and may be progressing unfavorably. A chest X ray may reveal tuberculosis or other lung changes that may accompany the arthritic condition. It is good to know whether the lungs are all right before starting treatment (especially if corticosteroids are used).

I try to explain to the patient with rheumatoid arthritis that he is

suffering from a generalized illness and that the swollen joints are merely one external manifestation of the disease. I insist on bed rest, a good wholesome diet with vitamin supplements and iron. The joints must be rested, perhaps even splinted to prevent deformities.

Salicylates such as aspirin help hold down the fever and the joint discomfort and contribute to the patient's sense of well being. The usual dose of aspirin that I prescribe in these cases is 10 grains four times daily, after meals and at bedtime. This amount can be increased slightly or decreased depending upon the patient's response and the emergence of side-effects.

Drugs, surgery may help

Corticosteroid drugs are of great value and can be used by themselves or in conjunction with salicylates. Although I may prescribe corticosteroids under their generic names I do believe that some of the more costly and trade-marked products are often more effective and have fewer side-effects. If the treatment with the corticosteroids is to be rather brief and the total cost of therapy not excessive, I may prescribe more expensive drugs.

In cases where the rheumatoid arthritis has been a long duration and the affected joints are stiff and deformed I refer the patient to orthopedic surgeons for whatever help they can provide. Today much can be done with "reconstructive" surgery, special exercises and well-planned physiotherapy. Even when crippling cannot be completely prevented, its damaging effects can be minimized.

Some kinds of arthritis demand a specific therapeutic approach. For example, joints that are infected may need antibiotics. Sometimes the fluid in the joint needs to be aspirated and cultured to determine which antibiotic can be used.

Although bursitis differs from arthritis in that the inflamed bursa is not in the joint but near it, its treatment is somewhat similar to that of arthritic joints. Usually I prescribe phenylbutazone or a combination of phenylbutazone and corticosteroids and then follow this program up with salicylates such as aspirin. In problem cases I advise injection treatment into the inflamed bursa. X ray therapy is also helpful but is not so much in vogue these days since medicine by mouth and by injection are usually more rapid and more effective.

Gouty arthritis is more common than is generally realized and requires special therapy. First, I take a blood test for uric acid because in gout there is more uric acid in the blood than normal. A high blood uric acid confirms the diagnosis. Secondly, I find out if the patient is taking any "fluid pills." Some diuretics used in high blood pressure and heart disease may bring on a gout-like condition by increasing blood uric acid. If this is the case I switch the patient to other diuretics.

In acute gouty arthritis, the kind that may awaken the patient from a

sound sleep, I prescribe colchicine. This ancient drug, derived from the yellow saffron plant, must be taken according to specific directions since excessive dosage causes diarrhea. In chronic cases of gout, I use aspirin, phenylbutazone, indomethacin and corticosteroids.

To prevent attacks of gout I may use probenecid since it increases the flow of uric acid from the blood through the kidneys and thus lowers the blood uric acid level. More likely I would also try another medicine, allopurinol, because of the remarkable ability that it has to prevent the body from manufacturing uric acid in the first place. With it, joints that seem helplessly damaged by gout may slowly recover.

Although I have stressed the medicinal treatments in this article, I must emphasize that I do not treat arthritic patients with medicine alone. There is much more to treatment of arthritis than mere medicine. What the arthritic patient needs is a total program—rest, exercise, heat, massage, diet—and medicines, too.

Patients often ask about the dietary treatment of arthritis since there is still widespread belief that arthritis might be avoided by dietary means alone. Food faddists and nutrition nuts keep this notion alive.

Truth is that with the exception of gout there is no specific diet or vitamin effective in the treatment of ordinary kinds of arthritis.

If a patient has scurvy it may cause arthritic changes but, thanks to readily available citrus juices, scurvy is rare nowadays. If a patient has rickets, he may need extra sunshine or extra vitamin D, but although rickets can soften bones and bow legs it has almost vanished as a disease in civilized countries. A vitamin B deficiency can cause nerve changes that may roughly simulate arthritic disorders but most doctors wouldn't be fooled. Vitamin E (wheat germ) deficiency causes no known clinical disease in man, so it, too, can be dismissed as a factor.

The dietary treatment of gout, on the other hand, is important and strict adherence to a low purine diet can reduce the severity and frequency of attacks. Although the body can manufacture uric acid from non-purine foods, a diet that is heavy in purine can increase the uric acid in the blood.

Since sweetbreads, kidneys, yeast, anchovies, liver and other highly "cellular" foods are rich in purines, they are best avoided.

In arthritis the doctor has to individualize the patient's problems. Each case must be studied on its own merits. Each case warrants its own special program of rest, exercise, diet and medical therapy. If you suspect that you have arthritis or some related disorder, you should see your own doctor.

INVENTIONS

Idea of the Month

Portable oxygen belt

THE BREATHERBELT, a magazine editor's brainchild, supplies emphysema sufferers with needed oxygen, leaving them free to move about.

The equipment includes a switch-operated valve controlled by movements of the torso, a container of oxygen slung from a shoulder strap and a plastic tube running to a cannula under the user's nose.

Each time the wearer inhales, a measured quantity of oxygen is released, and when he exhales, the valve closes.

James Finan, Pleasantville, N.Y., a department editor at The Reader's Digest, was told nine years ago that he had pulmonary emphysema, a lung condition that involves the destruction of air sacs. He was also advised that he needed exercise and more oxygen than he was getting from the air.

To gain both at once, he attached an oxygen cylinder to his bicycle and ran the tubing to his nostrils. But the constant flow of gas soon exhausted the supply.

The Breatherbelt, for which Jim Finan recently received Patents 3,400,712 and 3,400,713, releases oxygen only when the wearer breathes in. As people are exhaling more than half the time, no gas is wasted and a smaller container can be worn.

The equipment is not ready for the market, but prototypes are being tested at the University of Washington Medical School, Seattle; at the University of California Medical Center, San Francisco; and at Peter Bent Brigham Hospital, Boston.

From his own experience, the inventor knows the value of oxygen in emphysema. He keeps a Breatherbelt in his car for use in case of an attack of breathlessness. He also believes it will prove of value in heart cases; about 25 million Americans are affected by some form of cardiovascular disease.

The invention can be used in the hospital to monitor respiration in intensive care or to actuate respirators of the iron lung type. The portable form should release bedbound patients and shut-ins who have been tied down by heavy tanks. —*Stacy V. Jones*

Photos by Robert H. Wright

Marvelous miniature monsters

by Robert H. Wright

FOR CENTURIES man has waged constant warfare against insects and other small pests. But even the development of poisons and insecticides has not won the battle. In too many instances, for one reason or another, insecticides cannot be used.

Thus, today there is an increasing interest in biological control of these pests. People have discovered that an insect's natural enemy is a much more efficient exterminator than man. So why not let the expert do the job?

As biological control becomes more popular, more and more "experts" are being found. One such expert is a large lizard, the spiny swift. He has a unique specialty, one that can be valuable to man. As an exterminator of arachnids, especially spiders and scorpions, the spiny lizard is unexcelled.

Some 30 species of these lizards can be found in most of the United States, excluding the extreme northern states. And since the territorial range of a given spiny lizard is usually limited to a few hundred yards, it is conceivable that they could be stocked. If transported to

a locality that provides some "cover," along with plenty of food, they will likely stay put.

The spiny lizard's diet is made up of enormous quantities of spiders, centipedes, scorpions, a large variety of insects and even other small lizards. They have incredible appetites, especially some of the larger species which sometimes reach a length of ten inches.

But it is the lizard's appetite for the deadly black widow spider and the poisonous scorpion that puts him in good standing with humans. The poisonous bites and stings of the arachnids seem to have no ill effect on this lizard—if indeed their fangs or stingers are even able to penetrate the lizard's scaly armor.

The spiny's taste for scorpions and black widows is especially appreciated, since these arachnids are often too hardy to succumb to fumigation, or a mere spraying with insecticides. Arachnids are much tougher than insects, such as roaches, ants and termites. It is possible to cover a black widow with insect spray and yet not kill her. Unless the sprays get directly into her breathing apparatus, which is underneath her abdomen, she will likely go her merry widow way. Scorpions, with their hard exoskeletons, present much the same problem.

With such natural resistance to chemical insecticides, arachnids can be a very real menace. This is all the more true when the arachnid happens to be one with a dangerous bite or sting. But these pests have no such resistance to the spiny swift. He comes by the name "swift" quite honestly, because he is one of the fastest lizards in the country, particularly when after a meal. And when the meal is a poisonous spider or scorpion, he becomes a handy fellow to have around.

This unattractive little monster is known as the spiny swift. He is quite proficient as an exterminator—especially of creatures like annoying insects and menacing arachnids.

A fat little black widow spider is mighty tasty eating to the spiny lizard. This one he had to knock from her web, but when food is at stake, he's determined.

Another of the lizard's favorite foods has been nabbed (above). The venomous scorpion tries to sting his captor, but to no avail. So the spiny swallows his meal (below).

U.P.I.

Hibernating bear is awakened by curious hunter. Similar curiosity is shared by Jack W. Hudson, Cornell zoologist, who suggests that astronauts go into hibernation to extend life spans for space trips.

Hibernating astronauts

THAT OLD PLOY of science fiction writers, the man who extends his life span by suspending vital processes, may be a reality some day, says a *Cornell University* zoologist. Then man would be able to last out a space voyage to, say, a distant planet like Neptune and back, which would ordinarily take a lifetime or more.

There is a form of suspension of the vital processes which is fairly common in nature: hibernation. Jack W. Hudson, associate professor of zoology at Cornell, suggests astronauts copy animals and go into hibernation to extend their life span. He points out that some bats hibernate and live up to 20 years, while their relative, the non-hibernating mouse, may not have a natural life span of more than a year or two.

Hibernation is a result of depressed metabolism, the reduction of oxygen consumption which slows down the functioning of the body. In animals, it's used as a defense against environmental conditions such as extreme heat and lack of food.

Hudson, who works only with small mammals and birds, has discovered that the hearts of desert rodents will pump normally when their body temperature is reduced

from their normal temperature of 37 degrees centigrade to 15 degrees centigrade. But below 15 degrees the heart can't retain enough potassium, which helps stimulate the organ to beat of its own accord.

If the mechanisms regulating potassium were better understood, speculates Hudson, methods could be developed to keep the heart functioning at low temperatures over long periods of time. He thinks that other hibernation mechanisms can also be unraveled and applied to man.

Depressed metabolism is already being used on man in a type of heart and brain surgery called "bloodless surgery," in which the metabolism is depressed by dropping the body temperature with ice packs.

Hudson finds that the phenomenon of depressed metabolism is much more widespread among mammals and birds than was suspected previously. In the last four years, he has found 15 new hibernators, and he expects that many more will be found. Until 1964, the complete list of hibernators included only 23 animals.

Case of mistaken mummy

It was a little embarrassing to the curators of the Cairo Museum to find out that the small mummy identified as the baby of Queen Makeri, wife of a ruler of the 21st Dynasty, was really a monkey. But Dr. Paul V. Ponitz of the *University of Michigan*, and Dr. Arthur Storey of the *University of Toronto*, X-rayed the small bundle found in the Queen's tomb and came up with a plate that clearly shows the bone

Queen Makeri's baby, entombed about 1000 B.C., turns out to be a mistake. X rays show the 16-inch mummy bundle to be a monkey with glass or stone eyes.

structure of a monkey with glass or stone eyes inserted in its eye-sockets. This is the first time an animal has been found in a royal sarcophagus, although cats and alligators have been found buried with their owners in more recent graves.

The deeper the bigger

You're right—things do look larger underwater than they do topside. Two psychologists at the *University of California at Los Angeles* who are measuring underwater sight distortions say most divers see objects slightly larger than they are. The distortions are smaller among experienced divers and decrease when a novice remains underwater for a longer period of time. On the average, divers at UCLA saw a one-foot line as 14 inches long, but the line "shrank" to 13½ inches after half an hour in the tank. When the diver returned to dry land, the distortion worked in reverse, and he saw a foot-long rule as 11½ inches.

What volcano?

What happens to plant and animal life when a volcano erupts?

Dr. Paul A. Colinvaux of *Ohio State University* visited Fernandina Island in the Galapagos of the Eastern Pacific Ocean less than a month after a June 11 eruption had blown a mile-wide hole in the volcano crater. The volcano was still steaming and smoking when he climbed the 5,000-foot crater and looked in, but life on the uninhabited island was going on much as before.

"It illustrates that anything short of a Krakatoa does not destroy all animal life," says Dr. Colinvaux. Krakatoa is an island in the Straits of Sunda near Java that was almost completely destroyed by a terrific volcanic eruption in 1883.

A forest of Scalesia trees, a unique member of the dandelion family, was undisturbed by the blast, and otter-sized land iguanas were wandering about on Fernandina as if they had never been subjected to an eruption, he reports.

The Fernandina explosion was of much smaller proportions than the Krakatoa blast, but the recent eruption was described as "in the multi-megaton range" by an air-wave recording station at Boulder, Colorado.

The blast was of special interest to biologists because Fernandina has what Dr. Colinvaux describes as "the only true virgin relics of the old Galapagos fauna and perhaps the last truly virgin tropical community left on earth." On all the other islands of the Galapagos the unique animal life is vanishing before man, but Fernandina is defended by the barren lava flows of its outer slopes.

Until recently, Dr. Colinvaux says, the rich life in the clouds of Fernandina's summit was not only untouched by man, but also unknown to him.

All Photos BIPS

"Bad blood" is believed by Baders to be the cause of many ills. So it is drawn to skin surface by the suction of glass cups which are heated with a candle and applied.

Last of the barber surgeons

FIGARO—the fabled "Barber of Seville" who did a little of everything from pulling teeth and cutting hair to arranging marriages for the local gentry—has a modern counterpart, alive and operating in Hohenholding, Germany.

The *Bader*, as he is called, still practices blood-drawing; teeth-pulling; and pimple-, boil- and carbuncle-treating. He *also* cuts hair and shaves whiskers. Some think his leeches inject medicinal serum into the body, reducing blood pressure.

And it's all legitimate. The German government licenses Baders—a fast disappearing group—such as Jakob Kastenmeier and makes them promise not to take on patients whose ills require a real doctor.

Surgery business is slow these days for most Baders. Jakob Kastenmeier finds himself more of a barber than a surgeon, mostly doing tonsorial tasks, as above.

Leeches are the Bader's favorite method of blood-drawing, and he keeps jars of them around—just in case. He claims they inject serum while filling up with blood.

Pulling teeth (below) is only an occasional duty, but the convenience of having a haircut and a tooth extraction in the same chair may have something to be said for it.

Blood-drawing is being done behind this man's ear. Leech is held with a glass tube as it drains small amounts of blood. Leech drops off when filled to capacity with blood.

Springtime in Hohenholding is blood-drawing time. Baders believe blood moves at a higher pressure in the spring and that good therapy is to remove a little, as below.

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.

Sunspots—hot or cold?

If the temperature of the sun's surface is white hot, how is it possible for sunspots to be black? They would have to be cold to be black and how can anything on the sun be cold?

The question, as stated, would seem to be a real stopper. In fact, in the early 1800s, a great astronomer, William Herschel, decided that the sunspots must be cold since they were black. The only way he could explain this was to suggest that the sun wasn't hot all the way through. It had a white hot atmosphere, yes, but underneath that was a cold solid body and we could see that solid body through the rifts in the solar atmosphere. Those rifts we call sunspots. Herschel even thought the cool inner body of the sun might be inhabited by living things.

But this is wrong. We are quite sure now that the sun is hot all the way through. In fact, the surface we see is the coldest part of the sun and even that is surely too hot for living things.

Radiation and temperature are intimately related. In 1894, a German physicist, Wilhelm Wien, studied the kind of light radiated at different temperatures. He concluded that, under ideal conditions, every object, regardless of its chemical composition, radiated a particular range of light for each particular temperature.

As the temperature goes up, the wavelength of the peak radiation gets shorter and shorter in the same way for all bodies. At about 600°C. enough radiation slips down into the visible range to give the object a dull red appearance. Then, as the temperature goes higher still, the object becomes bright red, orange, white and blue-white. (If the temperature were high enough, the radiation would be almost entirely in the ultra-violet and beyond, and the body would be virtually invisible.)

By carefully measuring the wavelength of the sun's radiation peak (it is in the yellow-light region) we can calculate the temperature of the sun's surface and it comes to about 6000° C.

The sunspots are *not* at this temperature. They are some 2,000° degrees cooler, and we can put the temperature at the center at 4000° C. It seems that a sunspot is a mighty tornado-like expansion of gases, and such expansion, on the sun as in your refrigerator, causes a considerable temperature drop. It takes a mighty heat-pump to keep an enormous sunspot cool for days and weeks at a time against the heat flowing in from the surrounding hotter areas of the sun, and astronomers have not yet worked out a completely satisfactory mechanism for sunspot formation.

Even at 4000° C., the sunspots ought to be very bright. They should be considerably brighter than a carbon arc here on earth and a carbon arc is too bright to look at.

Well, the sunspot *is* brighter than a carbon arc and instruments check that out. The trouble is, though, that our eyes don't see light absolutely. We judge brightness by comparison with the environment. The hotter normal areas of the sun's surface are four to five times as bright as the cooler areas in the center of the sunspot, and by comparing the latter with the former, the latter seems black to our eyes. That blackness is a kind of optical illusion.

That this is so can be sometimes demonstrated during an eclipse. The eclipsing moon, with its dark side toward us is *really* black against the sun's bright globe. When the moon's edge encroaches over a large sunspot so that the spot's "darkness" can be seen right against the moon, it is possible to see that the spot is not really black.

—Isaac Asimov

Some scientists have thrown out the "don't-get-your-feet-wet" theory of winter cold prevention, according to reports I've heard about. Why?

Doctors know that any of more than 60 viruses can cause the infection called the "common cold." Studies that have been going on for 40 years or more have indicated the common cold is "caught" only when there is a source of infection; take away the viruses and you take away colds.

And while most doctors are not recommending that we disregard the traditional precautions against colds, there has been considerable research evidence that you don't catch colds from wet feet, chills or any of the usual cold weather discomforts.

Medical researchers at the Baylor University College of Medicine in Houston, Texas, have been doing experiments with various combinations of the traditional "causes" of the common cold. Forty-seven volunteers were subjected to chilly

Advertisement

Why Aren't You A Fast Reader?

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rooms, cold baths and, finally, a group of viruses known to be linked with the common cold.

The outcome was that the volunteers' environment seemed to have no effect on the frequency, severity or duration of the colds they caught.

A recent issue of the New England Journal of Medicine carried a report by R. Gordon Douglas Jr., Keith M. Lindgren and Robert B. Couch—the Baylor cold research team.

Their basic theory is that cold weather has an effect on the common cold only because it drives people indoors where there is a greater chance of virus infection.

Airborne water droplets can carry the viruses of someone else's cold for as long as three hours. A sneeze or a cough has a much greater chance of spreading infection in a hot, stuffy office or home than outdoors in the cold and the damp.

The studies at Baylor and elsewhere are not startling to physicians and scientists. There have been reams of circumstantial evidence for years that you can subject yourself to wind, rain, snow and chills for long periods of time without catching a cold—provided there is no cold virus present to infect you. This, of course, does not mean we should throw caution to the wind.

Instead, it's probably wise to go by the established rules of good health: proper diet, rest and frequent exercise, keeping in mind that more and more evidence is pouring in that colds have their origins in viruses—communicated easily indoors.

WEIGHTS *and* MEASUREMENTS

length
mass
time
temperature

by John and Molly Daugherty

WITH THE ADVANCES in science, technology and the space effort, accurate ways of measuring basic quantities are increasingly important—especially ways that are stable and readily reproducible. Fortunately, nearly all can be derived from a few basic units.

What do you know about standards of measurement?

1. The four basic quantities for measurement involve length, mass, time and temperature standards. These suffice for nearly all important measurements except for two recognized derived ones and a few not dependent on the basic units. All but one of the four quantities are now defined in terms of some natural constant. The one not so defined is
   a. Time
   b. Mass
   c. Length

2. The basic standard measurement of time is the second. It has been redefined several times. In October 1967, the 13th General Conference on Weights and Measures redefined the second as a
   a. Number of cycles of a specified frequency associated with the isotope Cesium 133
   b. Certain fraction of a selected tropical year
   c. Fraction of a mean solar day

3. The United States received two copies of the international standard meter bar in 1899. They were deposited with the Office of Weights and Measures in the
   a. Treasury Department
   b. Department of Agriculture
   c. National Bureau of Standards

4. Today the International Bureau of Weights and Measures defines the meter as
   a. One ten-millionth of the distance from the pole to the equator along a meridian line
   b. The distance between two lines on the *original* platinum bar in the archives
   c. A number of wavelengths (1,650,763.73) of a certain emission line of isotope krypton 86

5. Congress made it legal, but not obligatory, to use the metric system of weights and measures in the United States in
   a. 1776
   b. 1866
   c. 1889

6. Conferences on the metric system for international use led to a treaty signed May 20, 1875. It was soon ratified by
   a. More than 43 countries
   b. Thirty-five countries
   c. Eighteen countries

7. The National Bureau of Standards at the Boulder, Colo., laboratory maintains time with an accuracy estimated to be less than one second off in
   a. Sixty years
   b. Six hundred years
   c. Six thousand years

8. The standard which can be measured with the least accuracy is
   a. Length
   b. Temperature
   c. Time

9. Secondary physical quantities derive from the basic measurement units. Of these, the one which involves the three basic units of length, mass and time is
   a. Force
   b. Velocity
   c. Ohm

10. In 1960 the General Conference on Weights and Measures added two derived units to the basic four quantities of length, mass, time and temperature. This was done for convenience only since the two are not independent of the others. These two units are
    a. Color and sound intensity
    b. Ampere and candela
    c. Angle and triangle

Answers:

1—b Mass. The unit of mass was first defined as the mass of a cubic decimeter of water at its temperature of maximum density. This volume is one liter, and its mass, one kilogram. Later a *platinum* prototype of the kilogram was used for making copies of it with greater accuracy. In 1889 a new standard for the kilogram was made from *platinum-iridium* to replace the original.

2—a A number of cycles of a specified frequency associated with the isotope Cesium 133. The number of cycles (9,192,631,770) of the frequency associated with the transition between two particular energy levels of isotope Cesium 133 defines the second. The other methods used earlier, based on a rotating earth, are less accurate. Recent studies show that the earth is more irregular in rotation than thought to be. The atomic clock may be as much as 10,000 times more accurate.

3—a Treasury Department. The Office of Weights and Measures at that time was part of the U.S. Coast and Geodetic Survey in the Treasury Department. On July 1, 1901, the National Bureau of Standards became established, and the standard meter bars were transferred to it, where they now are. The bureau comes under the Department of Commerce.

4—c A number of wave lengths (1,650,763.73) of a certain emission line of isotope krypton 86. In 1960 the 11th General Conference on Weights and Measures in Paris redefined the meter this way. The length standard is a reddish-orange component of wavelength 6057.8021 Angstroms in the pinkish light emitted by krypton 86. The atomic method improves the accuracy about ten times over measuring the standard bar against a copy to be checked. The original platinum bar was replaced by a platinum-iridium bar in 1889. This bar will still be used for certain types of measurement.

5—b 1866. The yard (36 inches) was tied to the meter at that time, too, by designating the meter as equal to 39.37 inches. The yard equals .9144 meters.

The American inch equalled 2.540005 cm, but the British inch equalled 2.5399956. By agreement in 1958, and later legally ratified, Britain, Canada, Australia and the United States set the inch as exactly 2.54 cm. This uniformity was a big ad-

vantage to the machine-tooling industry.

6—c Eighteen countries. It took until 1954 for 35 countries to ratify the treaty. Now more than 43 countries have joined the metric system partly or wholly, and a number of countries are starting the change-over. Some latecomers to ratify the treaty are China, India, Japan and Egypt. Britain, at the urging of businesses which export to metric countries, hopes to complete the change-over by 1975.

7—c Six thousand years. The Bureau uses an atomic Cesium clock with an accuracy of one part in 10^{12}. This means that the Cesium clock, properly maintained, gains or loses less than one second in 6,000 years.

Earlier astronomical methods based on rotation of the earth to define the second could be off 30 seconds in about 60 years. The earth is more irregular in rotation than it was previously considered to be.

8—b Temperature. The temperature unit as now defined is the kelvin, or degree Celsius. It is 1/273.16 of the thermo-dynamic temperature of the triple point of water (.01 degree Celsius). In suitable apparatus, at this temperature, water, ice and water vapor are in contact. At present, accuracy is only to two decimal places.

9—a Force. From Newton's Second Law of Motion, force is expressed as $F = ma$. The dimensions of force include mass, length and time. The acceleration (a) is the time rate of change in velocity, and velocity involves length measure and time measure.

The ohm relates to length measure and time measure.

10—b Ampere and candela. The ampere is a unit of electric current, and the candela is a measure of luminosity.

Color measures are usually classification systems related to the properties of the eye. Angle measures are primarily ratios.

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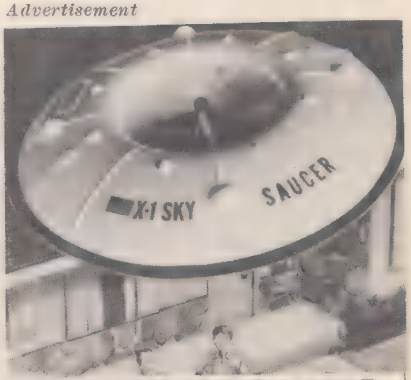

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The real space odyssey

Appointment on the Moon. By Richard S. Lewis. Viking. ($10.00)

If you've ever had the yen to look behind the scenes of our manned space flights; to listen to the men up there talking to the men down below; to have someone *there* explain the significance of a failure in a number 1 left thrust rocket; to have a competent scientist explain lucidly the excitement and meaning of newly discovered radiation storms and magnetic fields in the far reaches of space, then don't miss this book.

You are there—in the Gemini with John Glenn, walking in space with Gordon and Collins, in the blockhouse during the tense minutes before and during lift-offs, in monitoring stations spotted around the globe, in the smoke-filled rooms of the politicians and decision-makers who grease the skids or throw up road blocks, motivated by everything from love of country to power greed.

Besides being a gripping account of our entire space program —from Robert Goddard's stovepipe rockets to Apollo 5's successful unmanned flight, plus a thoroughly understandable record of the scientific achievements of the U.S. *and* Russia in space—the book comes close to being a "white paper" on our deplorable failures in the competitive race for the moon.

The author names names and pins the blame. He knows the space program inside and out and is a top notch science and political reporter to boot. You'll learn about Bobby Baker's tie-up with Apollo's prime contractors. Gen. Curtis E. LeMay, then Chief of the Army Air Force, is pin-pointed as the man who advised Dr. Harvey Hall that the Army would not support the Navy's satellite proposal in 1946. "It was the top brass," says the author, "that perpetuated rivalry and disrupted cooperative and economic development of rocket technology." The frustrations of Werner von Braun, whose "Jupiter C" stood ready to put a satellite into orbit months before Sputnik, are abundantly clear. So is the morass of political confusion that made an orphan of John Hagen and his Vanguard project. The miracle is that Hagen ever managed to put his "grapefruit" (as Kruschev called it) into orbit at all on the stingy funds and ill-considered policies with which he had to launch an untried rocket mechanically more sophisticated than any previously tried. As a matter of poetic justice for Hagen, however, Vanguard's little 6-inch sphere satellite became one of the most successful satellites of the space age. It's tiny radio transmitted signals for more than six years, "enabling scientists to observe changes in atmospheric pressure during solar activity, the influence of the sun's radiation pres-

sure on the orbit of a satellite and the atmospheric pressure at various altitudes." It also proved that the earth was pear-shaped.

What this 414-page book doesn't cover regarding the space race is hardly worth mentioning. It even provides the answer to a long-unexplained mystery — the "firefly-like" sparkles that John Glenn saw on each of his orbits. It turns out that on a subsequent orbit early in the program, one of the astronauts noticed the same phenomenon and did a little experimenting. He discovered that every time he thumped the hatch, the sparkles sparkled in space.—*RFD*

Other new books of interest

Too Short a Day. A Woman Vet in Africa. Susanne Hart. Taplinger Publishing. ($4.50). The trials and tribulations of a veterinarian are bound to be gargantuan, and those of a female "animal doctor" who practices her profession in the wilds of South Africa are almost unimaginable. The author tells her own story in a charming manner, injecting a great deal of humor, for many of her experiences with the animals she loved and their often difficult human owners were indeed quite humorous—such as the man who became quite indignant when the doctor didn't show the proper respect toward the idea of castrating his pet mouse; or the woman who asked her to come out to check the sex of her cats (27 in all) when her tom cat had just given birth to seven kittens. She was afraid there had been a sex change because the cat had definitely been male prior to the big event.

Toward the Year 2000. Edited by Daniel Bell. Houghton Mifflin. ($6.50). This is a progress report on what the Commission of the Year 2000, established by the American Academy of Arts and Sciences, is doing in its study of the future consequences of present public-policy decisions.

Birds of the Eastern Forest. John A. Livingston. Paintings by J. Fenwick Lansdowne. Houghton Mifflin. ($20.00). The companion book to *Birds of the Northern Forest,* published in 1966, offers a representative sample of birds that inhabit the Great Lakes area to the Gulf of St. Lawrence.

Soil Animals. Friedrich Schaller. The University of Michigan Press. ($5.00). There's a remarkable world of tiny creatures who live in the soil which we know little about. The routine of life and the constant fight to maintain it are explored here in an easy to understand manner.

The Mirages of Marriage. William J. Lederer and Dr. Don D. Jackson. W. W. Norton Co. ($7.95). One's first impression of this dissection of

marriage is that it's a rather unfair treatment of the whole institution. The authors, however, express the desire to do away with many of the myths of marriage that date back to the stone age and by so doing make workable marriages more likely and more prevalent. The book is for anyone with an interest in the subject and that doesn't leave out many.

Science for the Airplane Passenger. Elizabeth A. Wood. Houghton Mifflin. ($4.95). Here's a book that someone should have thought of long ago. It gives simple scientific explanation of the amazing things that occur both in the sky and to the airplane passenger, as well as offering exciting things to watch for if you'd rather look out a window than watch the movie. And who wouldn't?

McGraw-Hill Modern Men of Science Volume II. McGraw-Hill. ($19.50). This reference book presents biographical data on 420 leading men of science, including not only what each man has done, but how and why as well. Excellent source book for libraries.

The Lost Americans. Frank C. Hibbens. Thomas Y. Crowell Co. ($5.95). An updated version of a book published originally in 1946, this story of the first and subsequent discoveries of Stone Age man in America makes extremely good reading. Archaeological and anthropological buffs, as well as anyone who's just plain interested in the history of man, will find this easy to read.

Illusions. André Maurois. Columbia University Press. ($4.95). "The scientist strives to dispel illusions . . . the artist, on the contrary, strives to create illusions." So said the author, who died before delivering this manuscript as a lecture series at Brookhaven National Laboratory. The text is a thought-provoking study of illusions and how they affect man in his life everyday.

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IS Mailorder for you? Find out. Details, Value House, Dept. SD, 550 Fifth Ave., N.Y.C. 10036.

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DREAMS-LEARN their mysterious inner meanings! 110 page book, "How to Understand Your Dreams" Send $2.00, Tempo Center, 6355 N. Encinita Ave. Temple City, Calif. 91780 Calif. Res. add 5% tax.

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WANTED—MISCELLANEOUS

TEACHER wants back issues Georgraphic Natural History, Science Digest for class use. Martin 752 W. Dempster, Mt. Prospect, Ill. 60056

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MISCELLANEOUS

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WINEMAKERS-Free catalog and recipes. Kraus, Box 451-R, Nevada, Missouri 64772.

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Logic vs empiricism

Dr. Asimov's explanation of the "irresistible force/immovable object" question is, I think, unresponsive and irrelevant from a semantic and logical point of view. He states that the question is meaningless and requires no answer. But the question clearly asks, "What would happen IF an irresistible force met an immovable body." Dr. Asimov says that these contradictory concepts don't make sense in terms of rational techniques of exploring the universe. The question isn't concerned with whether or not an irresistible force could meet an immovable object in the material universe—it simply asks what would happen if they did meet. There is an answer that flows logically from this contradictory question.

It is easily proven by elementary logic that any conclusion at all follows from contradictory premises. Therefore the answer to the old chestnut is—everything and anything. The question may well be meaningless in the empirical world, but it has an answer in terms of pure logic.

JAMES A. MULLER
Toledo, Ohio

Author's reply

Apparently, a difference between "pure logic" and science is that when

a question is asked that involves a self-contradiction, pure logic says the answer is, to quote you: "Everything and anything."

Science says: "The question is meaningless."

May I humbly suggest that an answer that goes "Everything and anything" is but a grandiloquent way of saying "The question is meaningless."?

Isaac Asimov
West Newton, Mass.

Immovable over irresistible

If one reads quickly and carelessly, Isaac Asimov's explanation seems irrefutable.

When a man experiences the irresistible force that is represented by his love for and of a woman, and she refuses to budge until he apologizes, the irresistible force of his love will cause him to apologize that the immovable will move.

EMIL A. DALLMANN
Jamaica, N. Y.

Dr. Leakey defended

According to your "Bulletins at Press Time," (August '68), there are those who are skeptical of Dr. L. S. B. Leakey's find of human artifacts at the Yermo, Calif., location. It is a shame that those skeptics always remain in the background as great anonymous shrieks.

I would like to announce to these fierce paper tigers that Dr. Louis S. B. Leakey is absolutely correct in his basic theory of "early man" in North America. "Our man" *did* occupy the site discovered by Dr. Leakey, and assuredly Dr. Leakey knows how to identify early man's artifacts.

I have a valid discovery some miles north of the Yermo site. There is no guess work about the pre-history civilization and peoples who inhabited this very large and vital site for thousands of years when all ground lower than 6,000 feet in this part of Nevada and California was under water created by glacial melt water. Observation and study at my site disclosed many thin limey strata interpreted as ancient receding lake shorelines.

I have collected and indexed hundreds of "mint" condition (tools) artifacts from various locations at this site and have sent some of these tools to a museum for their examination with a descriptive covering letter stating that I have also located an extensive "core biface area," small caves with undisturbed floors and the potential of many bone horizons.

In the face of this evidence, a letter from the museum from an earth science type states, "It would be extremely difficult to determine whether these objects were ever used by man." Sound familiar? It is unfortunate that so many of these desk-bound dullards with (in most cases) no field experience of any kind and no valid discoveries of any nature to their credit can doubt in print the discoveries of a man like Dr. L. S. B. Leakey. "The desk-bound type" evolves a profound thesis without even really knowing the geographical location of the discovery or anything about the history regarding the site.

D. W. CAULDWELL
President, Nevada Mojave Inc.
Las Vegas, Nevada

Some facts missing

In your "Bugs and Mid-air Col-

lisions" news item (October '68) you referred to the collision of a Convair liner and a private plane (Cessna 150) as a possible bug-caused accident. I am sure that if you had all the facts available on this particular collision, this news item would not have been published. In your statement you are assuming that the small plane collided into the airliner, while the facts are that the airliner overtook and collided into the tail of the small plane. This collision occurred after the airliner had been warned three times by radar control that the small plane was in the area. Maybe the bugs were still on the airliner's small windshield and that is why they were not scanning the skies. If so, how did they find the runway to make a safe landing?

ROBERT F. BERGDAHL
Emporium, Pa.

The news item referred to was accurately reported according to all the facts available from federal investigators at the time of publication. Angles of collision were not positively and accurately determined until the National Transportation Safety Board's public hearing on this case in November—too late for us to verify the outcome in this issue.—Ed.

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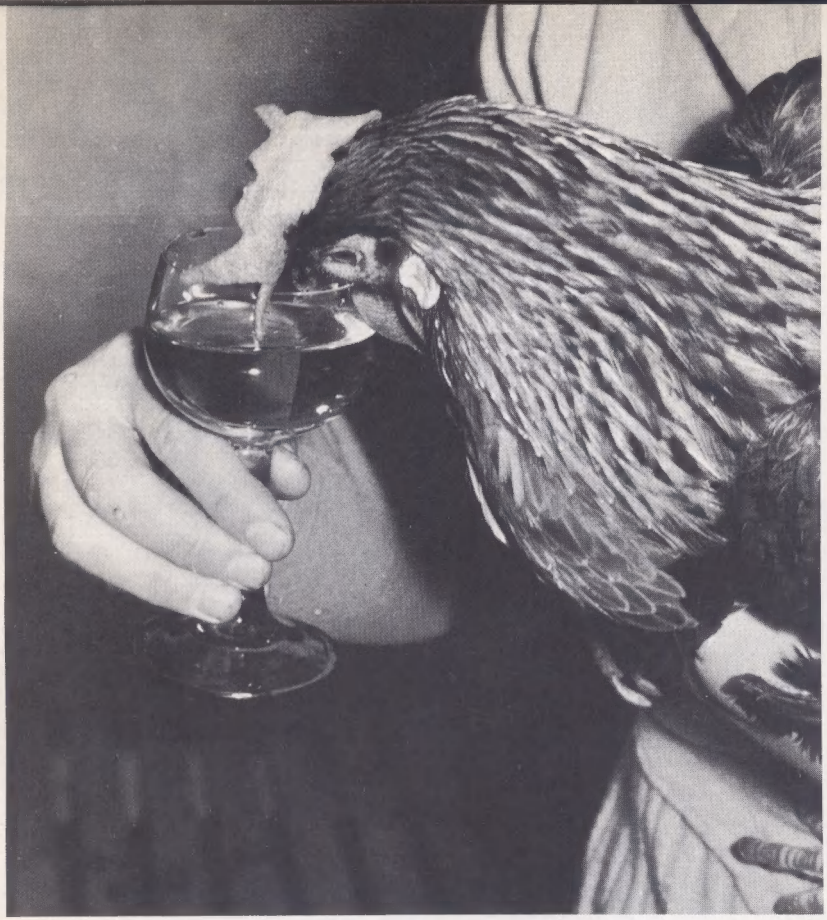

BIPS

A toast to the hen house

HUNDREDS of chickens get drunk for science at the Wine Research Institute near Würzburg, Western Germany. The institute is studying the connection between heavy drinking and liver diseases.

The birds daily consume a large quantity of wine—an amount that would correspond proportionately to several quarts for a human. The result is inebriation which leads to liver disease and eventual death.

It has been found that their livers react to alcohol in much the same way as those of humans. The most common liver ailment caused by alcohol in humans involves the build-up of fat in the liver; alcohol speeds up this deposition. The organ's function can be permanently damaged if the consumption of alcohol is prolonged.

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MICROCRAFT LAB

Microprojector shows microscopic subjects enlarged with brilliant detail on wall or screen. Has sturdy **Steel Cabinet, large Condensing Lenses** for extra brightness, and a GE Projection Lamp. **Microscope** features Ramsden Eye-piece for wide field viewing, Substage Light and Polarizing Filters. Magnifies up to 200X. Includes: **Slides, Cover Glasses** and **Microscopy Manual.**

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Measuring Wavelength of Light

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30X erect image. Extends to 30" length. Five ground and polished Lenses. **Ramsden Eyepiece. Sturdy Equatorial Mount** makes it easy to follow the movement of heavenly bodies. Mount has fittings for wooden legs that complete the tripod (legs are regular 1x2 lumber not included).

PHOTOGRAPHY LAB

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